Editorial

ACCORDING to report, the Postmaster-General, Mr. Anthony, is recommending a third network of National stations throughout Australia to cover the broadcasting of Federal Parliament.

It is pointed out that when Parliament is in session great demands are made upon the available broadcasting time of the ABC, which is deprived of a complete channel when the House is sitting.

There is both rhyme and reason in the suggestion. When broadcasts from Canberra were first mooted, many had grave doubts whether the listening public would be interested in them. "Interested" has proved to be scarcely an adequate word. We have been informed, instructed, amused, irritated and sometimes disgusted. There is little doubt, however, that the public wants the broadcasts continued.

The somewhat tense happenings of the last few years have probably been responsible for this, and they are no doubt the reasons why people still want to hear Parliament.

Creating a separate network, however, needs a little thought. The broadcast band is now more than occupied—too many channels are shared rather than too few. Can another network be accommodated without creating an impossible problem of frequency allocation?

Already it has been strongly advocated that our local stations be moved to the higher frequencies to relieve broadcast band crowding.

We do not know how the PMG proposes to fit in extra stations, but he must be very sure it can be done without prejudice to the present occupiers.

It might be possible to arrange a series of stations using the same frequency, as the programme material is the same, but there would be special difficulties to be overcome with such a system.

It is quite understandable that the ABC finds the allocation of so much time to Parliament exceedingly irksome in programme building. It isn't the best from the listener's point of view, either, for it severely restricts his choice. After all, there are periods of Parliament which are exceptionally dull, but which can scarcely be eliminated on that account. It must be all or nothing!

In principle, I think the scheme has much to recommend it. The third channel would be a boon to that small but important section of listeners interested in things other than racing during Saturday afternoons, for instance. I shall be most interested to see just how the PMG proposes to fit his new network into the scheme of things.

John Moyle

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RADIO AND HOBBIES IN AUSTRALIA

A NATIONAL MAGAZINE OF RADIO, HOBBIES AND POPULAR SCIENCE

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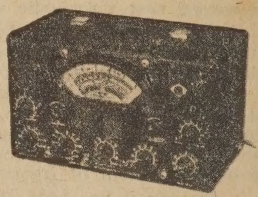

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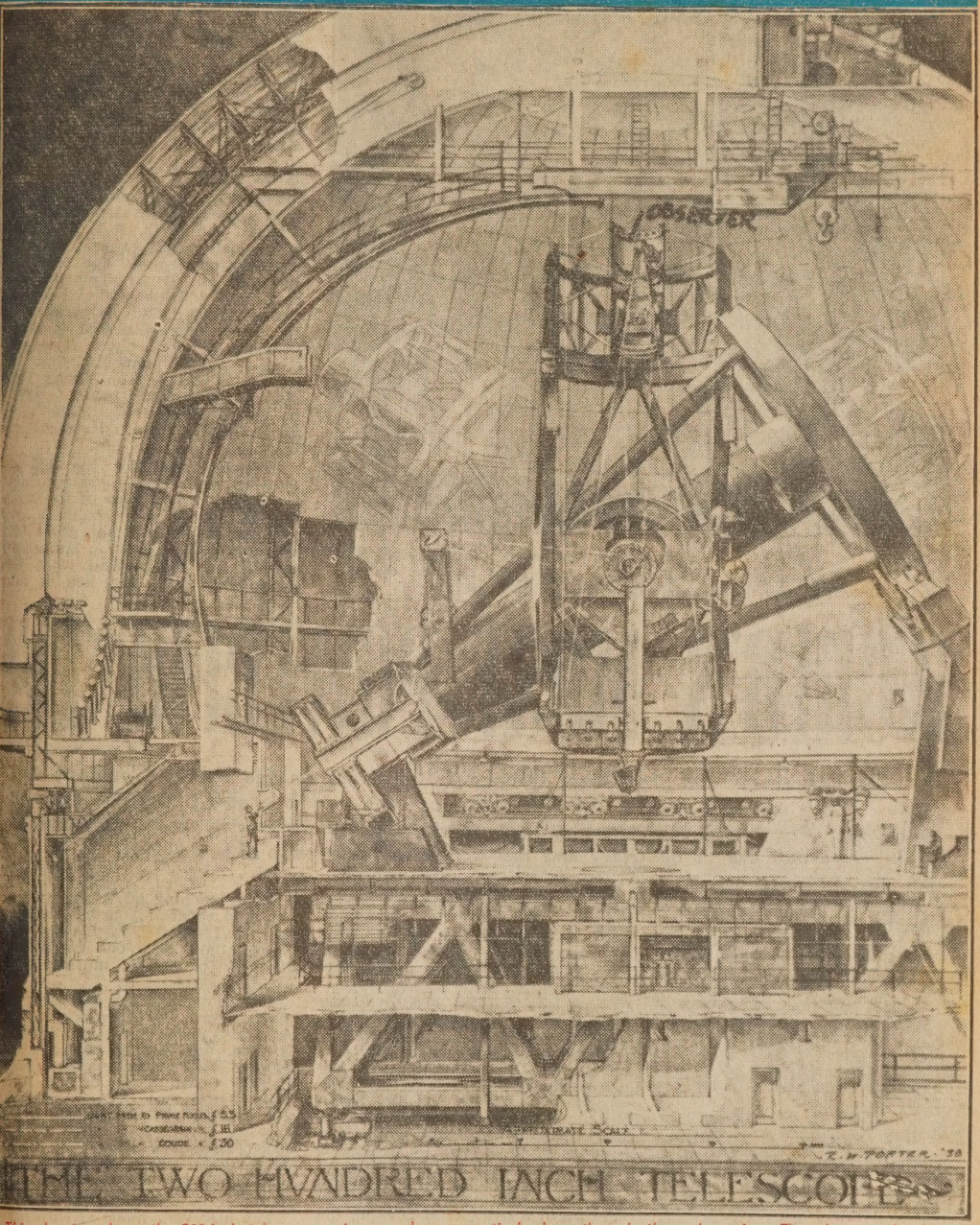
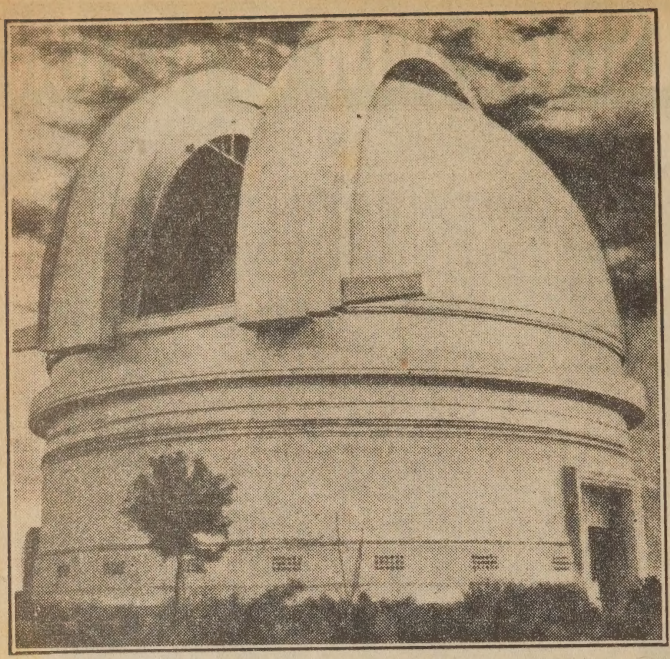


This drawing shows the 200-inch telescope, cut away along a vertical plane through the polar axis. The phantom drawings indicate how the observer gets on and off the tube. Contrary to popular belief, the Giant Eye will not be used for looking at stars, but to photograph small sections of the universe. While it would take merely 5½ years to photograph the universe with a 48-inch telescope, the 200-incher would require 35,000 years to do it, as the Palomar Giant takes in only 25 minutes, or a third square degree on each picture. Some of the exposures require as much as two consecutive nights. Photos are made on 4-x 5-inch negatives. The observer can adjust the automatically synchronized mechanism, following the movement of the stars being photographed, with the help of two regular microscopes.



The dome at Mt. Palomar is 137 feet in diameter and height. It weighs 1000 tons and needs six motors of three horsepower each to open and close the shutters. Foundations for the telescope and housing are built seperately

WORLD'S MOST POWERFUL EYE

American astronomers at the Mount Palomar Observatory on the Pacific Coast of the United States are now using a 200-inch telescope—the world's largest star-gazer—to look into space. So ends one of the most delicate construction feats ever attempted. Now begins a new era of discovery and research into the universe of new worlds.

AFTER 22 years of painstaking preparation, the world's largest telescope has begun to search the heavens from the top of lonely Mount Palomar near Pasadena, in the Pacific Coast State of California. Scientists everywhere are eagerly awaiting the latest photographs from this gigantic stellar microscope, hoping that they may decipher the mysterious code of outer space and bring in messages that will tell the story of creation.

THE IMPOSSIBLE

From the day it was first conceived by the American astronomer, Dr. George E. Hale, in 1928, the 200-inch star-gazer has been unique. Once called impossible by experts, its huge 15-ton mirror stands today the most perfect piece of optical engineering ever achieved. Yet, none of the work has been done on it by conventional methods. Every step of the process of shaping the 17-foot reflecting surface has required new, experimental techniques. Even the tests by which the great glass was proved to be correct had to be invented. No single part of its vast area—more than 30,000 square inches—is out of line by more than a millionth of an inch.

When the original disk of pyrex glass arrived in Pasadena for grinding and polishing, it was flat on top, and had to be hollowed out, by several inches. The glass technicians had a fearful responsibility. If they took off just a few millionths of an inch too much glass, the mirror surface would be ruined and the entire area would have to be reshaped, a process that would take years. So they spent five months, polishing by hand and with a special machine for a few minutes at a time, then hoisting the great disk into the telescope and testing the work by actually observing a distant star.

POLISHING

In the course of that five months the total polishing time was less than seven hours. The rest of the time was used for checking and in waiting for weather perfect enough to be sure the tests were accurate.

The 200-inch telescope is designed for work at extreme range, catching the light from stars and nebulae some 4,000,000 times fainter than the faintest light the human eye can see. Exceptional care and precision is necessary in collecting the data from the sky and in interpreting its message. Infinitesimal variations in the character of the starlight indicate enormous differences in cosmic conditions.

FIRST TASK

One of the worst sources of errors is the turbulent envelope of air that blankets the earth. It is filled with very small particles; heat makes it shimmer and waver, and wind and moisture fill it with moving currents and whirlpools that break up beams of light. But sometimes the air above Mount Palomar is almost perfectly still and clean. It was for these special moments that the American scientists on Mount Palomar spent so many years to create an instrument that would be virtually without error in its records of starlight.

The first task for the 200-inch telescope is to check more accurately what is already known of the structure of the universe. Gradually, over the past 30 years, other great telescopes have been looking farther and farther into space. And what they have found is a huge sea of star-worlds, reaching off in every direction and apparently never coming to an end. These star-worlds are called nebulae, and each one seems to be made up of tens of millions of individual stars.

The most amazing discovery was made about 20 years ago by the American astronomer, Dr. Edwin Hubble, and his associates at the Mount Wilson Observatory on the Pacific Coast State of California. They found that these nebulae are not standing still or drifting but are rushing away from the earth at speeds that grow greater the farther off they get. Some of the most distant bodies seemed to be escaping at 20,000 or 30,000 miles per second.

The discovery made scientific history, because it suggests that the universe of flaming star-masses was exploding. As a first hazardous guess the British astronomer, Sir Arthur Eddington, devised the Theory of the Expanding Universe, as incomprehensible to the average man as Albert Einstein's theory of relativity.

Actually, Albert Einstein mathematics played a major part in the British astronomer's conclusions. The situation seemed to show that one cannot conceive of the universe with the human mind at all. One may only picture what is nearby. To understand the whole, one must resort to mathematical formulas that only a few specialists can understand.

But the observations of these cosmic mathematicians showed only a tiny fraction of the whole. They had not been able to look far enough to come anywhere near the extent of the universe.

It was at this point that Dr. Hale proposed the 200-inch telescope, on the reasonable chance that its power would actually reach to the point where the star-worlds began to thin out. He hoped that this new sampling of space would be extensive enough to indicate how the whole was constructed.

TEXTURE OF UNIVERSE

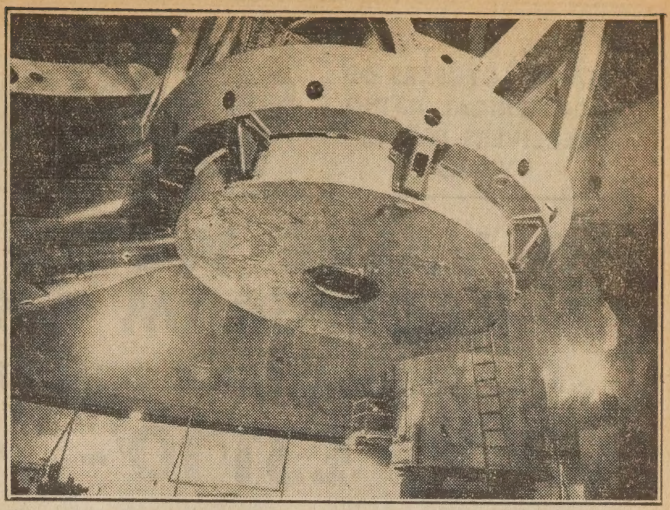
The scientists at Mount Palomar are now studying a file of pictures taken to see whether there is any evidence of a change in the texture of the universe. In other words, whether the distribution and spacing of star-bodies significantly changes out there. Also, whether these most distant nebulae are whizzing away at the speeds Sir Eddington's theory says they should be. This cannot be done by putting even the best trained eye to the telescope. Even the total light gathered by the 200-inch mirror cannot be seen. It must be made to fall on supersensitive photographic plates for many hours, sometimes for weeks, night after night, in order to capture any record at all. When strong images have at last been obtained, the plates must be analysed under microscopes, then measured and interpreted.

SPECTROGRAMS

The simple direct photograph of a distant star-body is not the principal kind of data to be sought. Much more valuable is the spectrogram of the light received. A huge glass prism is set in the throat of the telescope and the light coming through is broken up into a band of colors. When this strikes a sensitive photographic plate a small streak of black is left on it. By measuring the width and density with microscopic accuracy the astronomer can tell how much of iron, carbon, hydrogen, helium, and many other elements are present in a nebula millions of billions of miles away. This reveals a great deal about its size and age and about its speed through space.

Test photographing with the 200-inch telescope began in January, 1949. About 60 photographs were made before it was decided in May that further polishing of the mirror would be necessary before the finest results could be obtained. High spots—a few millionths of an inch—around the outside edge of the mirror were removed. This work was completed late in 1949.

Auxiliary equipment will now be added. One supplementary lens will give the 200-inch telescope the same focal length as the 100-inch telescope on Mount Wilson and allow direct comparisons between photographs taken with both instruments. A giant spectrograph will stretch out the tiny bands of light to many feet and will reveal cosmic detail as intimately as the microscope reveals a disease germ in a medical laboratory.



This massive concrete disc, held in place by huge bolts, substituted for the 200 inch mirror during the construction. It was exactly the same weight and shape as the mirror.

Nearly 7,000,000 dollars and the active lifetimes of many men have been dedicated to the giant telescopes on lonely Mount Palomar.

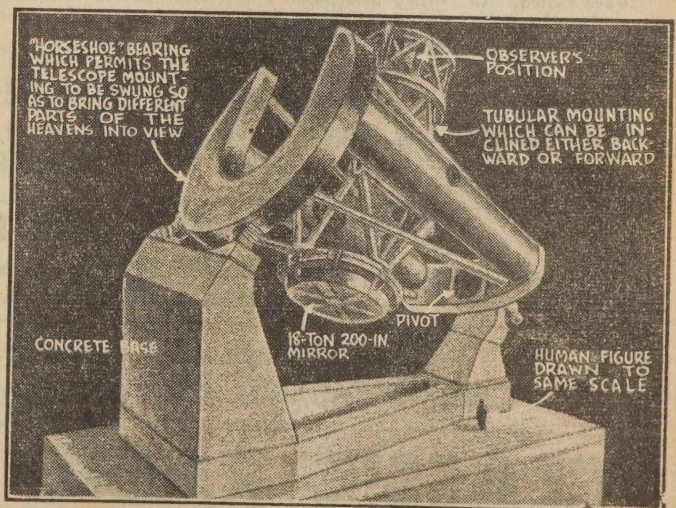
A fascinating book could be written around the purely human side of this vast project—the problems, the discouragements, the successes which have marked its progress from an ambitious scientific dream to an engineering reality.

It is one thing to calculate angles and dimensions on paper, but it is quite another to give them substance, when the calculations have to be reproduced to a millionth of an inch in twenty tons of glass. There were many who believed that the job could never be done.

The first attempt to pour the mirror met with disaster when the heat and weight of the molten glass collapsed the iron bars in the mould. Other difficulties were met, and it was not until December, 1934—nearly a year after the initial attempt—that the mould was successfully filled.

Nearly another full year was needed for the tedious process of cooling the glass, for the temperature had to be lowered at the snail-pace rate of 1 degree Fahrenheit per day. Right in the middle of the

(Continued on Page 7)


"HORSESHOE" BEARING WHICH PERMITS THE TELESCOPE MOUNTING TO BE SWUNG SO AS TO BRING DIFFERENT PARTS OF THE HEAVENS INTO VIEW
OBSERVER'S POSITION
TUBULAR MOUNTING WHICH CAN BE INCLINED EITHER BACKWARD OR FORWARD
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CONCRETE BASE
18-TON 200-IN. MIRROR
HUMAN FIGURE DRAWN TO SAME SCALE

This sketch shows the actual telescope unit itself together with its housing. It is a structure separate from the building. The disc in the centre is the mirror. Note man at bottom right drawn to scale.

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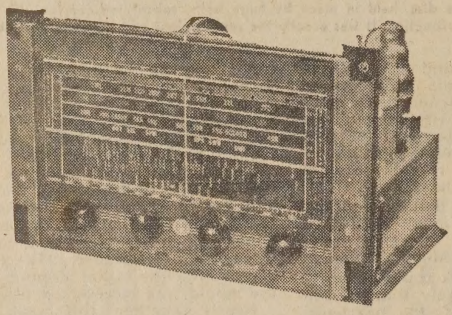

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A FACE LIFT FOR FIGHTER PLANE

A remarkable picture of a Sabre jet, ace American fighter, prepared for an engine overhaul. The fuselage has been parted to expose the jet power plant which gives the F86 its amazing performance in combat.

WORLD'S MOST POWERFUL EYE

(Continued from Page 5)

process, in July, 1935, floods threatened to submerge the site and ruin the whole project.

Ultimately, the rough cast was deemed fit to move, but how do you transport cross-country a priceless 20-ton slab of glass, over 17 feet in diameter?

Engineers solved the problem by building for it a special railway truck, with the smallest possible clearance above the permanent way. The huge slab of glass was carefully packed in cork and ultimately into a huge steel case, which cleared the tunnels by only a few inches.

PRECIOUS CARGO

With trucks fore and aft to take any possible impact, a loco. hauled the precious cargo to Pasadena for the grinding process.

Those who undertook this task were faced with the problem of removing about four tons of glass from the surface to form the shallow reflecting dish. The work had to proceed slowly and carefully, lest the heat generated by the process set up damaging strains in the glass.

Greater care and precision had to be exercised as the grinding passed from the rough to the finishing-off stage.

PRECAUTIONS

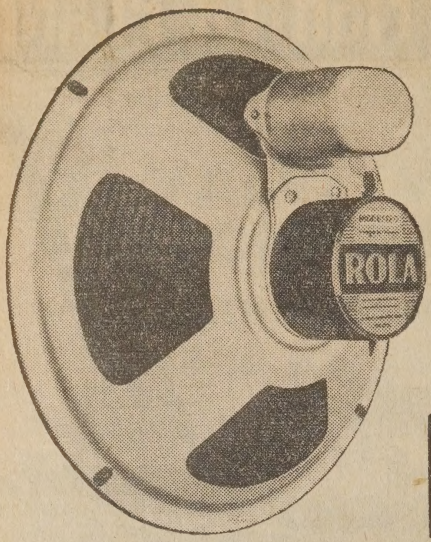
The mirror and the highly-trained workers were shut up in an air-conditioned room lined with three inches of cork and with a temperature held constant to within 1 degree Fahrenheit. Visitors who wanted to watch had to do so through thick plate-glass windows, these precautions being designed to exclude dust particles which might find their way into the grinding paste.

In rapid sequence the grinding powder was poured on to the surface, then washed off again lest the temperature of the surface be raised. And, for the polishing, a literal ton of jewellers' rouge was used.

MOUNTING

The mounting itself was another engineering triumph. Swinging on the world's largest bearing journal, floating on a high-pressure film of oil, the giant telescope moves at the bidding of a tiny half-horsepower motor. And so perfect is the mounting that even such a small motor is hundreds of times more powerful than it strictly needs to be.

But the Mount Palomar telescope is a reality and, even as its huge mirror stares into space, scientists are planning for a new giant which will be half as big again and with more than twice the surface area.



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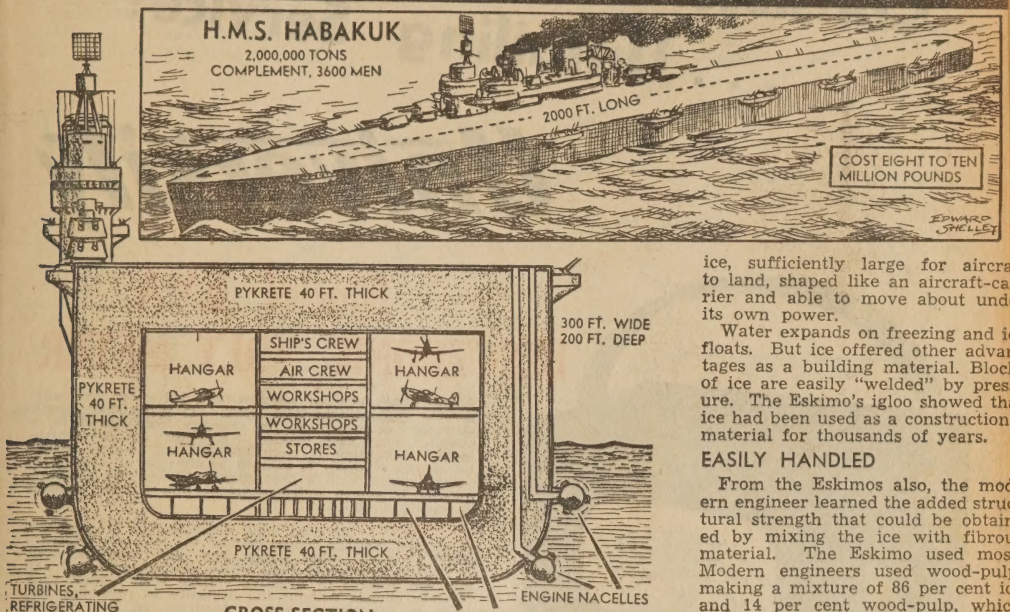
BIGGEST SHIP WAS NEVER BUILT



One of the most daring projects which was mooted during the last war was HMS Habbakuk —a colossal aircraft carrier built from ice. Fantastic as it may appear, the scheme was based on sound engineering principles.

by Professor A. M. Low

IN 1940 and 1941 it became apparent that a key to keeping open the vital lifeline across the Atlantic was the construction of an "island" in the middle of the ocean on which aircraft could land and refuel.

They could thus maintain the anti-U-boat patrol in an area, which, when they were based on Britain or America, was outside their useful range.

There was nothing very novel in the idea. Before the war, designs and models of an artificial, floating landing-ground, known as a "seadrome," had been prepared. It was proposed that these seadromes should be anchored at intervals in the Atlantic, thus making the crossing by civil air lines possible in short "hops."

The seadrome was essentially a platform supported well above the waves which would pass through the structure, leaving the platform steady in the worst storms. It was to be anchored by large mushroom anchors after being towed into position.

THE SEADROME

The seadrome type of structure was no doubt, considered by the military authorities and rejected, probably on the grounds that they would be too vulnerable to attack by submarines and aircraft, and that, being stationary, they would be unable to provide the "headwind" which helps landing on an aircraft-carrier.

In fact, a type of "seadrome" was evolved and used by the Royal Navy as a device known as "lilly," a landing strip composed of hexagonal floats ingeniously fitted together so that they were steady enough for an aircraft to land, but flexible enough to take the strains imposed by the waves.

This, however, was an emergency water-landing strip, and not suitable for all the year round use in mid-ocean.

SHIP OF ICE

In September, 1942, Mr. Geoffrey Pyke put forward a proposal for a revolutionary floating aerodrome which had none of these disadvantages. The idea was taken up and the work that followed, although it never reached maturity, ranked as one of the most remarkable pieces of research of the war.

Mr. Pyke's proposal was for ice, sufficiently large for aircra to land, shaped like an aircraft-ca rier and able to move about und its own power.

Water expands on freezing and i floats. But ice offered other adva tages as a building material. Bloc of ice are easily "welded" by pres ure. The Eskimo's igloo showed th ice had been used as a construction material for thousands of years.

EASILY HANDLED

From the Eskimos also, the mod ern engineer learned the added struc tural strength that could be obtain ed by mixing the ice with fibrou material. The Eskimo used mos Modern engineers used wood-pul making a mixture of 86 per cent ic and 14 per cent wood-pulp, whic nothing less than a floating island o was called Pykrete after the inven tor.

Once frozen into blocks, this material could be handled like wooc or plastic, being machined, sawr and cut to any desired shape. The material has great strength and hardness. In tests, quite thin pieces were shown to be "bullet proof," and the ice aircraft-carrier would have been virtually unsinkable, able to survive bombs and torpedoes.

Numerous tests were carried out and one large-scale model of HMS Habbakuk was made. The finished aircraft-carrier, its hull built up of Pykrete blocks, with refrigerating pipes running through to keep them frozen in warm waters, would have been 2000 feet long, 300 feet wide and 200 feet deep. It would have had the enormous displacement of 2,000,000 tons—compared with the 80,000 tons of the largest ships afloat.

OUTBOARD MOTORS

It would have had resinous insulation inside and out, and the interior would have been fitted out like an aircraft-carrier with space for planes and crew's quarters. Because of its size, the aircraft using it would not need folding wings as in the case of an orthodox aircraft-carrier.

(Continued on Page 11)

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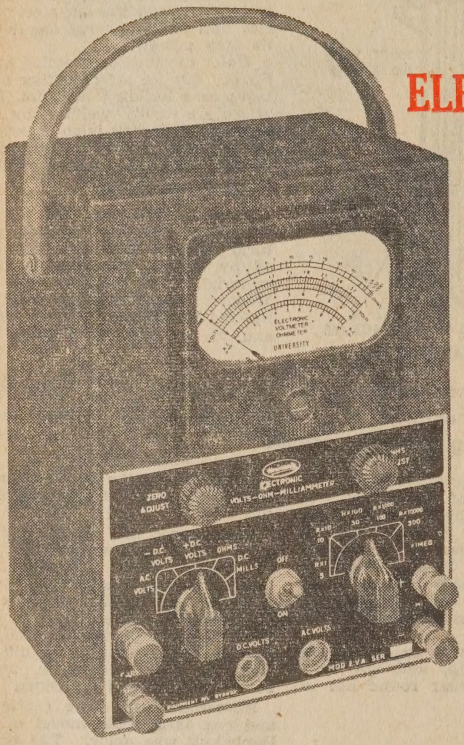

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is the ideal form of vacuum-tube voltmeter for radio service and experimental work. It is reliable, simply operated, accurate and is ruggedly constructed in a compact metal case, making it a perfect portable instrument. Operation is from 240 volt A.C. power mains. Consistent accuracy is assured by the use of a balanced bridge circuit with a high degree of negative feedback making it almost independent of line voltage changes or ageing of tubes.

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A.C. VOLTS. The input resistance on all A.C. voltage ranges is 1 megohm. Accuracy at 50 cycles is plus or minus 2 per cent of full scale value. Frequency response varies from the 50 cycle value by no more than plus or minus 3 per cent or .25 decibel between 30 and 20,000 cycles. This means that the instrument can take frequency response curves of gramophone pick-ups or audio amplifiers. The instrument is completely electronic on alternating voltages, no copper oxide rectifier being used. Unlike simpler and less effective instruments it responds to the "mean" value of both half cycles of an alternating wave and consequently does not suffer from "turnover" effect. It is calibrated in effective values of a sine wave and due to the much more constant relationship between mean and effective values than between peak and effective values, any error introduced by distorted signals will be much less than with the simple half-wave peak reading type.

OHMS. Six ohms ranges are provided covering values from 0.2 ohms to 1000 megohms. The extensive coverage is not only ideal for all ordinary resistance tests but also for condenser leakage and insulation testing. No external batteries are required and a single adjustment to zero on any ohms range is equally effective on all other ohms ranges.

D.C. MILLIAMPS. Six ranges of D.C. Milliamps cover values up to one ampere. The milliamps ranges do not require connection of the instrument to power mains.

R.F. VOLTS. An input socket is provided on the case to allow an external plug-in diode rectifier probe to be connected for the measurement of R.F. voltages up to 100 volts at frequencies as high as 100 megacycles. This probe is available as an extra.

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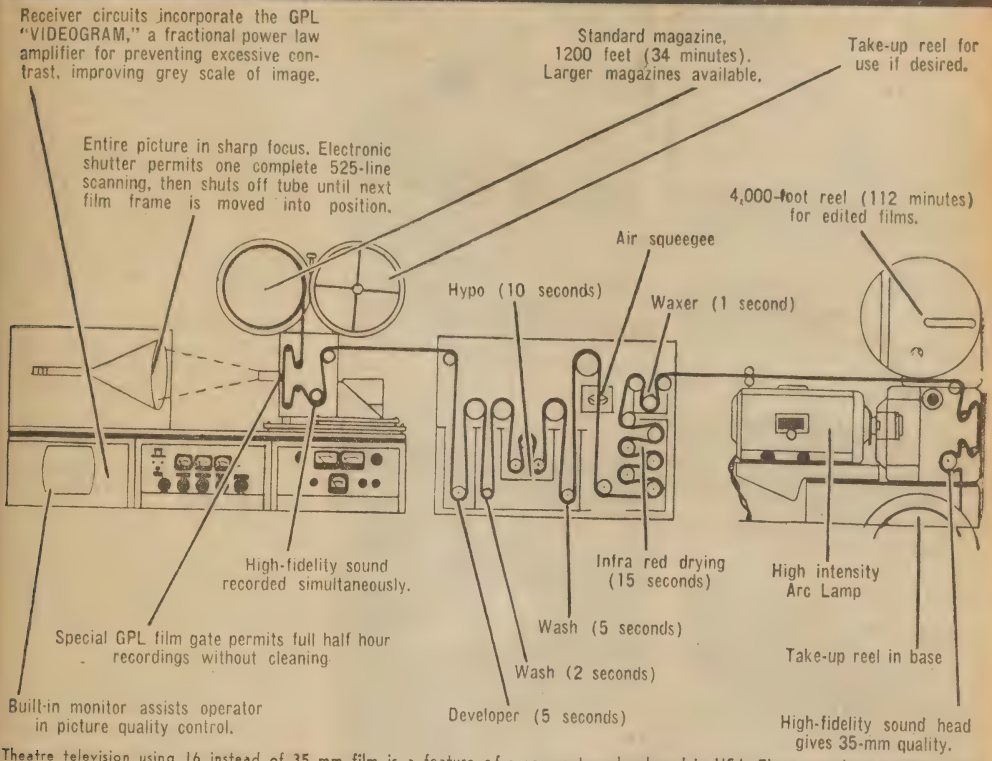
16MM FILM SCREEN TELEVISION


Receiver circuits incorporate the GPL "VIDEOGRAM," a fractional power law amplifier for preventing excessive contrast, improving grey scale of image.
Standard magazine, 1200 feet (34 minutes). Larger magazines available.
Take-up reel for use if desired.
Entire picture in sharp focus. Electronic shutter permits one complete 525-line scanning, then shuts off tube until next film frame is moved into position.
4,000-foot reel (112 minutes) for edited films.
Air squeegee
Hypo (10 seconds)
Waxer (1 second)
High-fidelity sound recorded simultaneously.
Infra red drying (15 seconds)
High intensity Arc Lamp
Special GPL film gate permits full half hour recordings without cleaning
Wash (5 seconds)
Take-up reel in base
Wash (2 seconds)
Built-in monitor assists operator in picture quality control.
Developer (5 seconds)
High-fidelity sound head gives 35-mm quality.

Theatre television using 16 instead of 35 mm film is a feature of a new system developed in USA. There are three units—a video recorder which photographs the tube, a high speed processor and a 16 mm projector. Sound is flat from 25-7000 cycles.

Biggest ship was never built

(Continued from Page 9)

Propulsion would have been by 26 electric motors fitted in nacelles, 13 in each side.

Unfortunately, when all was ready, and when even the building sites and method of construction on wooden rafts had been decided upon, the turn in the tide of the Battle of the Atlantic led to the decision not to proceed with this great project which would have cost eight or ten million pounds.

There is every reason to suppose, however, from the tests on the models that HMS Habbakuk would have been successful, and it is a pity we could not have had the comments of U-boat commanders and enemy aircraft pilots on this very unorthodox vessel.

It must not be supposed, however, that all this work was wasted. It gave us experience of large-scale refrigeration which will be of great value to engineers. We are apt to think of refrigeration primarily in terms of food preservation, but it has other uses on a large scale.

Huge masses of concrete, such as are used in modern dams, have to be refrigerated to prevent unequal expansion during the setting time.

It also gave experience, for the first time, in the large-scale handling of ice as a building material. It has certain advantages, such as lightness and cheapness, which make it possible to consider it for temporary structures even in peacetime.

ICE-WOOD PULP

The lightness and strength of an ice-wood pulp mixture might make it possible to contemplate buildings of a size and type not possible with concrete and steel because of weight-strength ratios.

For ordinary purposes, however, it is likely that the cost of installing and maintaining permanent refrigerating machinery to prevent the ice melting would render this method quite uneconomic.

It may be another matter when the long-talked-about exploitation of the Antarctic continent begins. We have good reason to believe that in the Antarctic are vast stores of coal, gold and other minerals, and that one day enterprising men will begin to exploit them.

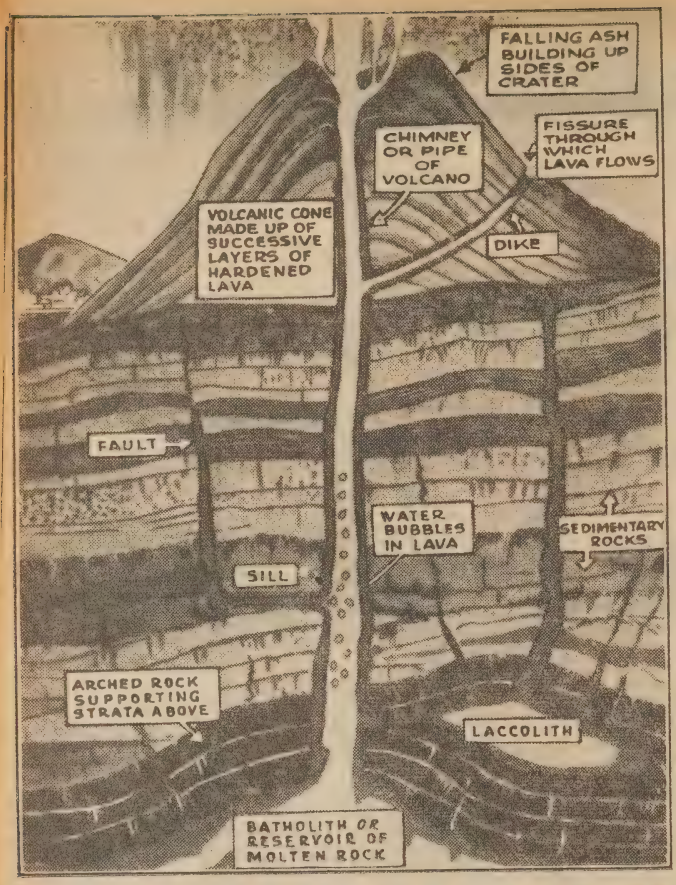
HMS Habbakuk shows how the buildings and factories necessary might be built—there would be no need to install refrigerating plants to preserve the ice.

Ice cities would save the great cost of taking building materials to the Antarctic, and the constant winds of considerable force which make the Antarctic so unpleasant could be harnessed to provide electricity to heat the interior of the structures so that work could proceed in an artificial climate.

Atomic energy may, one day, solve all heating problems.

But the chief reason why HMS Habbakuk was valuable, although never brought to completion, was because it showed that the spirit of imagination and daring is not dead, and demonstrated that there is no project the modern engineer cannot tackle, given the facilities.

Achievements of this kind make it abundantly clear that most of the floods, famines and droughts so long entitled "Acts of God" are, in fact, the consequence of the laziness of man.


FALLING ASH BUILDING UP SIDES OF CRATER
CHIMNEY OR PIPE OF VOLCANO
FISSURE THROUGH WHICH LAVA FLOWS
VOLCANIC CONE MADE UP OF SUCCESSIVE LAYERS OF HARDENED LAVA
DIKE
FAULT
WATER BUBBLES IN LAVA
SEDIMENTARY ROCKS
SILL
ARCHED ROCK SUPPORTING STRATA ABOVE
LACCOLITH
BATHOLITH OR RESERVOIR OF MOLTEN ROCK

This diagram shows how a volcano is born from the molten heart of the earth.

It is assumed that the crust of the earth approximates a depth of 40 miles. This crust is solid. Beneath this there is a mass of mobile liquid basaltic rock. Though mobile and fluid this mass is extremely rigid because of the enormous pressure built up around it.

The rigidity is proved by the fact that waves of disturbance, as shown on seismographs when recording earthquakes, pass through this liquid hot mass. These waves would not pass through a non-rigid mass.

Whilst volcanic action is of a varied nature, there is one feature which is common to all types. That is the ejection of boiling molten rock called lava, or, more technically, magma.

HIGH TEMPERATURE

The temperature of this molten mass is some thousands of degrees. It consists of liquid rock, in which is dissolved gases of various kinds, which escape into the air whilst the molten mass freezes into what is known as igneous rock.

There are two main types of volcanic eruption, namely, the quiet and the explosive.

In a quiet eruption the hot lava rises to the surface of the crater, thus forming a lake. It may remain there, rising and falling slightly, or it may flow over the side and form a stream which devastates the countryside for many miles distant.

The explosive eruption is of a violent nature occuring intermittently. It is not uncommon for a volcano to remain dormant for many years, then suddenly burst into activity with such a violence as to explode the mountain, throwing to a great height huge rocks and debris.

These eruptions are frequently preceded by rumblings and tremors due to the forces exerted by the steam and gases trying to get out.

When the explosion takes place the gases, together with fine ash, are thrown many thousands of feet into the air. Sometimes molten lava is also thrown into the air. This becomes aerated by steam and escaping gas. Quickly solidifying, it falls to the ground as "pumice" stone, riddled with small holes, and extremely light. Pumice stone is familiar enough to warrant no further description.

Eruptions are also typed as "central" eruptions or "fissue" eruptions. The central eruption takes its name

WHEN VULCAN BLOWS HIS FIRE

The word "Vulcanologist" has had some prominence during the past few weeks. This is a strange word to many people. To those it has been heard for the first time in connection with the disastrous eruption of Mount Lamington in Papua.

A VULCANOLOGIST is simply one who makes a study of volcanoes. The world, volcano, is derived from the Latin word, "Vulcanus," the term given to the Roman god of fire, whose forges were supposed to be located beneath Mount Etna.

The vulcanologist's job must be highly interesting. He has to make his way to the rim of volcanoes and peer down into the smelly depths. He never knows when a fifty-ton rock will be thrown up to hit him in the eye.

Imagine literally standing on top of a volcano while tongues of flame and spurts of molten rock and hot mud are thrown up around you.

Some people do take on strange occupations.

The basic causes of volcanic eruptions must be known to the vulcanologist to enable him to forecast with any accuracy if and when an eruption is to take place. For that is part of his job. He must make a close study of the history and geography of land surfaces for him to determine whether a volcano does actually exist beneath any given area.

by Calvin Walters

from the fact that the disturbance takes place around a central point.

The "fissure" eruption is so called because the flow of lava emanates from a crack or fissure in the earth's surface.

In the simpler kind of fissure eruption the fissures extend down to the bottom of the earth's crust. This is about 40 miles, which fact makes the fissure an "abyssal" one.

Before the crack is torn open, the pressure at the bottom is very great. It is everywhere equal to the weight of the crust above it. Assuming this to be 40 miles, the pressure is 270,000 pounds to the square inch.

ISSUE OF LAVA

When the crack is opened, this pressure on all sides is considerably reduced, with a consequent loss of rigidity and an increase in fluidity of the molten materal beneath.

The rise of the hot lava up the fissure for a distance of about 40 miles is due to a number of factors.

Firstly, the rise is assisted by the pressure of the heavy earth crust on each side.

It has been found that the density of the molten lava is lower than that of the earth's crust. Thus the crust would tend to squeeze the lava from the crack.

The molten mass is highly charged with gases, which, on release of pressure when the crack opens, leave the main mass and rise to the surface.

There is a well-known phenomenon which illustrates this. When the top of a bottle of aerated cordial is removed the reduction of pressure causes the imprisoned gas to rise to the surface. If the liquid is thick the resulting effervescence may cause the contents of the bottle to be forcibly expelled from the narrow neck of the bottle.

Such a condition also assists the molten lava in its rise to the surface. When the lava has risen to the surface a reversal of the forgoing action takes place. The weight of the lava in the crack becomes almost equal to the weight of the crust before the crack developed.

The pressure at the base of the crack is increased to its normal value and the rigidity of the molten substratum is restored.

SOLIDIFICATION

Thus the lava column tends to remain at the level of the earth's surface.

After a time, because of radiation of heat from the molten lava, the liquid mass tends to solidify. Especially is this the case with the mass close to the walls of the fissure. Here the heat is lost by conduction to the earth through the walls of the fissure.

Finally, the whole mass solidifies and the fissure becomes filled with solid lava, harder than the surrounding earth crust.

Thus there is not much danger to the earth's crust from a fissure eruption. The greatest danger is, of course, from an overflow of lava which may devastate portion of the countryside. This overflow may be caused by an abnormal basal pressure combined with a greater gas content than usual, together with a more sudden splitting of the earth's crust. This will cause a sudden rise of lava and an overflow before pressures adjust themselves to normal.

The central type of eruptive volcano and the one most feared is also regarded as commencing with a fissure, but, whereas the fissure type is somewhat short lived, the central type has a very long life. It is also usually intermittent over a great number of years. Mount Etna is regarded as being more than 100,000 years old.

If a fissure type volcano tends to freeze up, why does a central type volcano, which is also regarded as having started as a fissure, continue?

The reason lies in the peculiar local conditions which exist in the molten substratum of lava. This lava is of a very gaseous type, and it is this gas which transfers heat from the depths to the upper lava, thus keeping it in a continually molten state.

The gases which were imprisoned in the molten lava are released when the pressure is reduced. They rise to the surface in the form of millions upon millions of hot bubbles.

As these bubbles rise to the surface they enter regions of decreasing pressures. This causes them to expand, and in expanding their speed of ascent is increased. They rise faster and faster and bring their heat with them.

In addition to this, the bubbles impregnate the lower portion of the molten lava, thus reducing its density. It also rises to the surface in the form of a spongy thick solution.

When this spongy liquid reaches the surface the gases escape and the density of the liquid increases. It sinks again through the main lava column and a fresh batch of hot spongy liquid starts on the way to the surface.

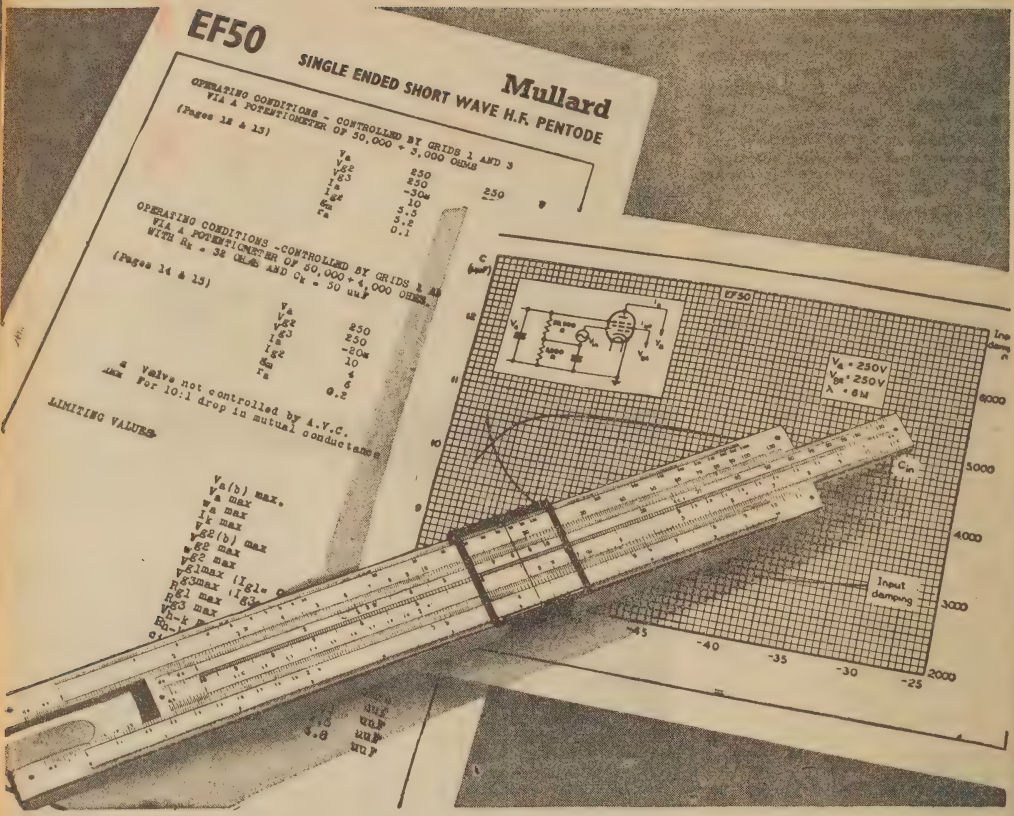
Thus there is a continual transference of heat from the 40-mile depths, and the column of lava in the vent is kept in a molten state.

However, this transference of heat is intermittent because the conditions

(Continued on Page 93)

A flow of lava on the floor of the mighty Vesuvius.

The crater of Vesuvius from the air. A splendid example of how the cone is built up.


EF50
Mullard
SINGLE ENDED SHORT WAVE H.F. PENTODE
OPERATING CONDITIONS - CONTROLLED BY GRIDS 1 AND 3 VIA A POTENTIOMETER OF 50,000 + 2,000 OHMS
(Pages 12 & 13)
OPERATING CONDITIONS - CONTROLLED BY GRIDS 1 AND 3 VIA A POTENTIOMETER OF 50,000 + 4,000 OHMS
WITH Rk = 32 OHMS AND Ck = 50 mfd
(Pages 14 & 13)
LIMITING VALUES
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Technical Review

RESEARCH TECHNIQUES WITH MILLIMETER WAVES

In between the longest light waves and the shortest radio waves is a region of electromagnetic radiation which is as yet unexploited. Research workers are faced with the very real problem of generating adequate energy for effective research.

RESEARCH into this unexploited region has proceeded from two directions. The most obvious approach has been with the aid of equipment intended to generate and measure light and heat rays but modified to give maximum efficiency in the region beyond infra-red.

The limit to this technique lies in the very small amount of radiant energy available from "hot" sources of illumination at the required wavelengths and extremely sensitive measuring devices are necessary to record it. Heat-detecting bolometers using thin wires are necessary or Golay cells, which measure heat by the expansion of a small body of confined gas.

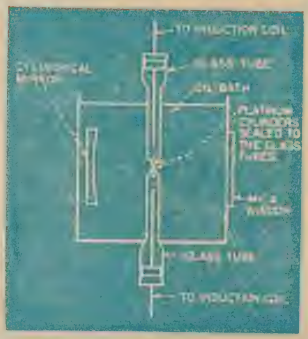
Even then, the energy must be integrated over a considerable period, so that measuring equipment becomes sluggish in operation and liable to increased error. Finally, at 1000 microns, or 1 millimeter of wavelength, the whole technique of infra-red spectroscopy reaches its limit.

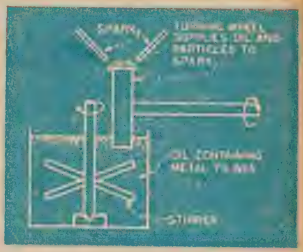
HIGHER POWER

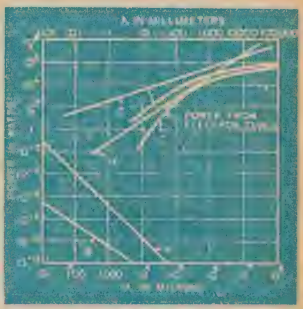
To generate higher orders of power, physicists have resorted to "incoherent" generators, or devices which produce energy in the required region but of random wavelength. The spark transmitter is an example of the same technique in the early days of radio.

As long ago as 1895, Lebedew, in the Moscow University, generated 0.6 mm waves with a spark oscillator. More recent applications of this technique have used tiny ball bearings, bouncing between charged electrodes, or a stream of mercury droplets striking an electrode.

From 1920 onwards, energy has been produced over the range from 129 to 50,000 microns using a technique whereby metal particles in an oil bath are fed into a spark.







Above, a diagram of the original Lebedew 0.6 mm spark oscillator and, at the top right, a later source of millimetre waves using metal particles in oil. On the right, a graphical summary of penetration to the millimetre region. A and B show radiation powers from hot bodies, while C indicates the much greater power from electron tubes and the way it falls short of the 1mm region.

The exact theory behind all these devices is open to some doubt but they all suffer from the same basic limitation, namely their broad band of output. Attempts to plot characteristics against frequency are especially difficult, since means to observe radiation over small increments of the band severely limits the amount of energy available for measurement.

The basic circuit of a reflex klystron, an oscillator which has been used down to wavelengths of about 5mm.

One of the helpful phenomena for research in this region is that molecules in vapor absorb millimeter waves and offer a handy yardstick for measurement and calibration.

Approach from the radio angle, through electron tubes, offers what is inherently a coherent power generating source. However, a theoretical triode for 50,000 Mc work would need to be of prohibitively small dimensions, involving a length of one-hundredth of an inch and a grid wire diameter of one one-hundred-thousandth part of an inch.

Another difficulty is that extremely small tubes cannot dissipate the heat generated internally by their own inefficiency.

The basic triode structure must therefore give way to the newer magnetron, klystron, reflex klystron and travelling wave techniques which promise high frequency output from more feasible structures.

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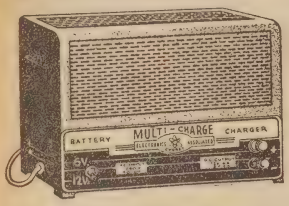

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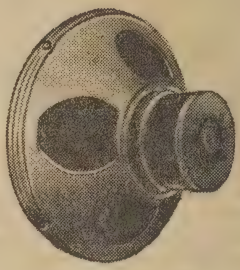

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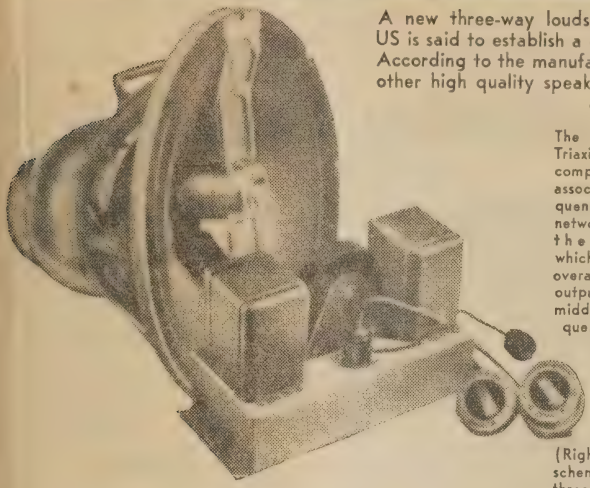
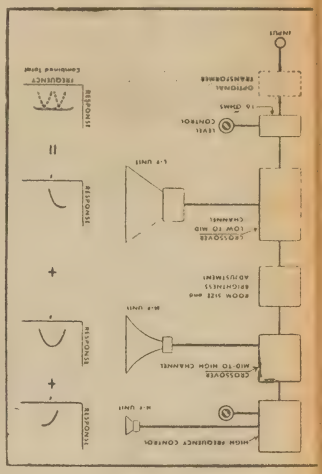
TRIAXIAL SPEAKER SETS NEW STANDARD

A new three-way loudspeaker developed by Jensen Engineers in the US is said to establish a completely new standard of sound reproduction. According to the manufacturer's claims, exhaustive listening tests against other high quality speakers have left no doubt about the performance of their latest design.



The new Jensen Triaxial speaker, complete with its associated frequency dividing network. Note the controls which set the overall level, also output from the middle high frequency units.

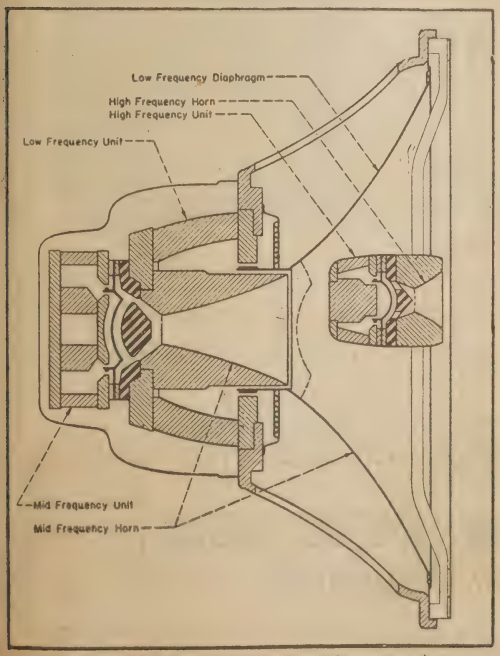


(Right) a block schematic of the three-way speaker. The level control is used to balance the output from individual speakers in a multiple-speaker installation.

AS the name suggests, the speaker is fundamentally three units in one, each unit covering a specific portion of the frequency range.

During the initial research, the designers rejected the claims of single and twin-cone loudspeakers, also of a combination of one "woofer" and one "tweeter." It is claimed that, in the present state of the art, it is not possible to make a single tweeter speaker which will cover a large proportion of the range and retain satisfactory characteristics at all frequencies.

The common failing is to make the mass and pole clearance sufficient to handle the lower frequency components and this results in a poor and generally overstated performance at the upper end.



Cross-sectional drawing of the new Jensen speaker.

As a result, it was decided that three distinct radiators would have to be provided, each especially designed for optimum results over a limited portion of the range. The resultant speaker would necessarily be expensive but well suited for the most ambitious listening from live material, high quality tape, and so on.

The main bass speaker, which operates up to approximately 600 cps, uses a rigid and specially curved 15-inch cone, driven from a 3-inch voice coil. A large suspension "spider" maintains accurate centring at all volumes.

Cone damping is assisted by the provision of a 6½-pound alnico V magnet.

The mid-frequency unit, which operates up to about 4000 cps, has a completely separate magnet and voice coil structure behind the main large magnet. Being designed for only a limited response, this second unit uses a rugged re-entrant diaphragm, with adequate clearance to ensure ample power and low distortion over the middle range.

HIGH FLUX DENSITIES

A dual, concentric magnet structure provides 17,500 gauss in the airgap. Output from this cone is coupled to the outer air through a horn structure which is continued by the curvature of the main cone. The dimensions of the horn are such that its characteristics remain good over the whole required operating range.

The small tweeter, which is mounted separately in front of the main cone, again uses a high flux magnet structure, mounting to 15,500 gauss around its 1-inch voice coil. Nominal response is from 4000 to 20,000 cps, the output being only 3db down at 18,000 cps in relation to the mid-frequency range.

The speaker is supplied complete with a separate chassis which carries a completely engineered frequency dividing network and controls which allow overall level and the response in the middle and upper registers to be varied at will.—(From "Audio Engineering.")

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Model 510 is a Combinette type Cabinet large enough to take a 5 Valve D/W Set with a Single Motor.

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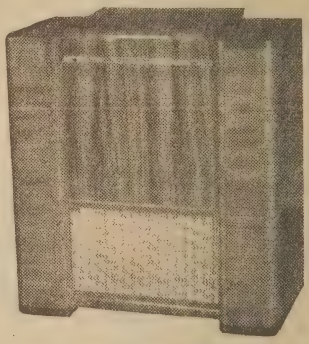

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ELECTRIC ORGAN USES NEON TUBES

In an effort to produce a lower-priced electronic organ, an American experimenter has produced a prototype instrument, which should retail for less than one third of the price of the cheapest current model. The basic tones are generated by a series of interlocked neon tube oscillators.

DESCRIBED in "Electronics," the organ is a small single-manual instrument.

The manual and key switches are part of the one basic unit which also carries the oscillator circuits.

A series of tone tabs give a selection of tone colors separately in the bass and treble registers, the switching being arranged so that the volume builds up as the tone colors are added, giving the same effect as traditional banks of reeds or pipes.

The amplifier is installed in the base of the console and feeds into two 8-inch permag. speakers, having staggered cone-resonance characteristics.

TWIN TRIODES

With the emphasis on economy, six twin triode valves are used to provide twelve phase-shift master oscillators, having operating frequencies corresponding to the notes of the top manual octave. These very stable oscillators are used purely for frequency control.

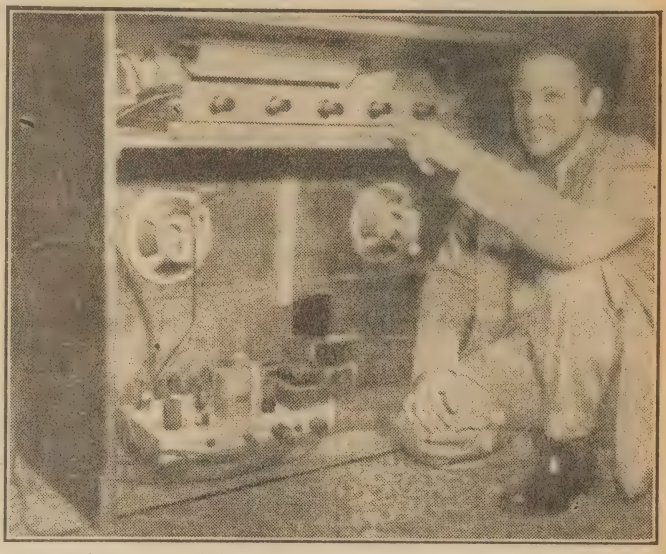
The actual tones are generated by relaxation oscillators using cheap Neon globes, the first bank operating on the same frequency as the master oscillators. Thereafter, succeeding banks for the lower octaves are locked in step with the Neon oscillator in the octave above. Lowest individual frequency is 69 cps.

Care is necessary in the choice of resistors to keep each relaxation oscillator within normal range of control. Oscillators which did drift out of control during early experiments involved cases of Neon tube changes and a process of ageing was evolved.

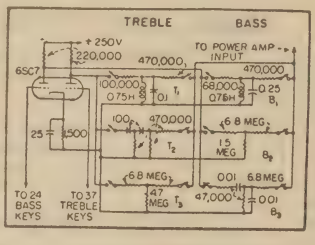
A fixed amount of illumination is also provided, since incident light affects the striking characteristics.

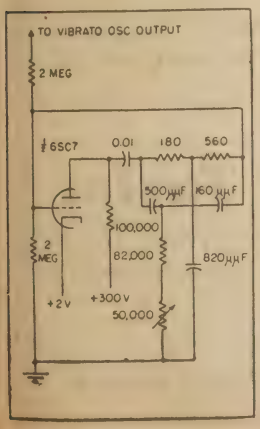
Since the output of the oscillators is rich in harmonics, the different tone colors are achieved by running the output through several filter steps which remove the harmonics progressively and therefore make available progressively more pure tone color.

Nichrome V wire was found to give most click-free characteristics for the key switches, operation of the keys having a double pole action which plays the note at reduced, then at full volume as the key is depressed.



A rear close-up view of the self-contained console. Note the six master oscillator tubes protruding from the tone generating chamber, which is integral with the keyboard.





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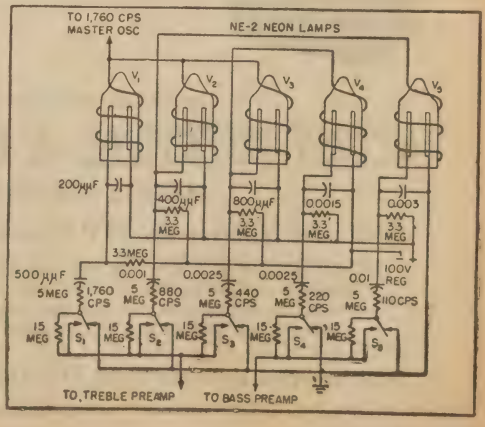
The diagram on the right shows details of one 5-octave divider chain, locked to the master oscillator. A few turns of wire round each neon oscillator trigger the oscillation. Note also the two-step action of the key switches. On the left is a typical master oscillator circuit which would control this octave chain. A 6-cycle oscillator gives a tremulant effect, when required, mainly by modifying the frequency. The small circuit above, though rather crowded, indicates the type of filtering which is applied to the tones.



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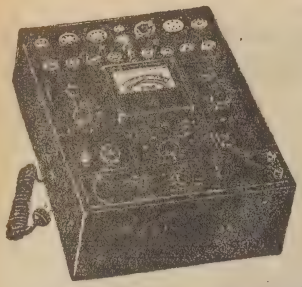

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Fitted with large direct reading meter with illuminated dial and OVERLOAD PROTECTION. Tests over 2000 American English and Continental valves including latest types. Filament volts range from 1.1 volts to 117 volts. Filament continuity and element shorts shown directly on meter. Cathode leakage read in megohms. The instrument is housed in a solid oak carrying case and supplied with comprehensive instruction manual. Also available as valve tester minus multitester ranges—Model 45 A-S.

MULTITESTER RANGES. 1000 ohms per volt A.C.-D.C.

D.C. Volts	D.C. Current	A.C. Volts	Resistance
0-120 m.V.	0-0.6 mA	0-3	0.5-22.5-1000 ohms.
0-3	0-6 mA	0-15	50-2250-100,000 ohms.
0-15	0-30 mA	0-150	x 500-22,500-1 megohm.
0-150	0-150 mA	0-300	x 5000-225,000-10 Megohms.
0-300	0-1.5 Amps	0-600	
0-600			x with external battery.

PRICE £41/15/- Plus Sales Tax.

IMMEDIATE DELIVERY

MODEL 75A

RANGES 20,000 ohms per volt A.C.—D.C.

D.C. Volts	A.C. Volts	A.C.-D.C. Current	Decibels	Resistance
0—0.1	0—1	0—50 uA	—30 to —5	1—50—10,000 ohms
0—2.5	0—2.5	0—5 mA	—22 to +3	1000—50,000—10 Megohms
0—10	0—10	0—50 mA	—10 to +15	*10,000—500,000—100 Megohms
0—50	0—50	0—500 mA	+4 to +29	
0—250	0—250	0—5 Amps	+18 to +43	*With external battery.
0—1000	0—1000		+30 to +55	

This is a robust 20,000 ohms per volt 50 range universal multimeter designed for accuracy and stability. Fitted into an attractive case, the meter is provided with instantaneous OVERLOAD PROTECTION. The clear, easy to read scale has a length of 4 inches. An internal buzzer is provided for quick continuity tests. Complete with test leads.

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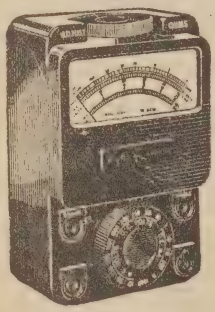
MODEL 120A POCKET MULTIMETER



RANGES 1000 ohms per volt A.C.—D.C.

D.C. Volts	D.C. mA	A.C. Volts	Resistance
0—0.25	0—1	0—10	0.5—20—2000 ohms
0—10	0—10	0—50	50—2000—200,000 ohms
0—50	0—50	0—250	*500—20,000—2 Megohms
0—250	0—500	0—500	*5000—200,000—20 Megohms
0—500		0—1000	
0—1000		0—2500	*With external battery.
0—2500			

This is an accurate pocket size instrument using a robust, sensitive meter movement fitted with instantaneous OVERLOAD PROTECTION and is housed in a high grade moulded case. All resistors used for voltage and current ranges are adjusted to an accuracy of 1%. Supplied complete with test leads.

PRICE £10/10/- Plus Sales Tax.

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NEWS AND VIEWS OF THE MONTH

Tests at 3000 MPH

ONE of the difficulties in testing aircraft and projectile designs for high speed operation lies in creating an air stream moving at a high enough velocity. There is a limit to wind-tunnels of conventional design, which cannot build up enough pressure to satisfy the requirements of scientists and designers.

Latest method of creating air blasts up to 3000 mph is to first build a large metal sphere which is evacuated until an almost perfect vacuum is obtained.

When release valves are opened, air rushes back into the sphere due to the 15lb per square inch pressure of the atmosphere. Air velocities of 3000ft per second have been reported.

So far experiments have been made with spheres up to 35ft in diameter, which create the desired air blast for a period of 15 seconds. Longer blasts and higher velocities would be obtained by using bigger and better spheres.

Scientists estimate that the speed required for propectiles to penetrate the earth's atmospheric envelope and reach the outer space would be 25,000ft per second. So they still have a fair way to go before tests at this speed are possible. They claim however, that data obtained at even half speed will be suitable for calculations to be made which will hold good at the higher rate.

Fresh water at sea

SINCE ships first took to sea on long voyages, the problem of obtaining and maintaining fresh water supplies has always been a poser. Even modern ocean liners are often faced with difficulty and expense in preserving their supplies—this when all round them is a vast expanse of water made useless for most purposes because of its "salt."

The news this month tells of a new device capable of distilling enough sea water to make a big ship virtually independent of outside supplies. The cost of distillation is less than one shilling per ton—well below the cost of filling up at many of the world's ports.

According to report, one of the few places in the world where it is just as cheap to buy water as it is to distil it is Australia. The figure quoted for our ports was 8d per ton, probably the cheapest water for ships in the world.

Filtering atomic water

AND speaking of water supplies, yet another report speaks of a small filter weighing only 8 ounces capable of filtering from water 99.9 per cent of bacteria, and 98.3 per cent of radio active particles. This technique is in direct opposition to the practice during the last war of using sterilising tablets which purified water without filtering.

The protection of this method was never as high as the figures given for the new device, nor did it remove mud and slime which often made the sterilised water almost undrinkable. At any rate, the US Forces have been sufficiently impressed by this latest invention to order large quantities of them.

What USA is seeing

WITH 10 per cent crime drama, 14 per cent vaudeville, and fine arts less than one per cent. The American Association of Educational Broadcasters is worried lest television waste itself as it is claimed radio has done.

A breakdown of the programmes available in New York works out as follows:—

- Religion, one per cent.
- Public events, one per cent (news-telecasting).
- Weather, less than one per cent.
- Comment and discussions on public events, two per cent.
- Dancing, less than one per cent. Music, four per cent.
- Information, science, travel, three per cent.
- News (visual news-announcing), five per cent.
- Fine arts, less than one per cent.

Then came the programmes which take the big slabs of television's time:—

Children's sessions, 12 per cent.
Crime drama, 10 per cent.
Housewifely arts, especially cooking, 16 per cent.

POPULAR SCIENCE QUIZ

Q.—What is a Geiger counter and how does it work?

A. This is a device for detecting particles or radiations emitted by radioactive substances. It consists usually of a tube either metal or glass internally silvered, with a wire down the centre, and containing an inert gas, such as argon, under low pressure. Between the wire and the wall of the tube there is a high voltage but not quite high enough to allow a discharge across the open space.

If an alpha particle (the nucleus of a helium atom) or a beta particle (an electron) goes through the gas between the wire and the wall of the tube, some of the gaseous atoms are ionized or broken, and they permit a discharge to pass. This may be amplified and fed to a loud speaker or some other device for registering or indicating the counts.

It will also detect indirectly the gamma rays (which are like X-rays of very short wave length) produced by radioactive processes. The gamma ray hits an atom in the material of the tube, knocking out an electron, which, in turn, causes ionization of the gas within.

Q.—We were told at school that the axis of the earth is inclined at an angle from the vertical. What is the effect of this?

A. If the axis were perpendicular to the plane of the earth's orbit, all parts of the world would experience a twelve-hour day and a twelve-hour night all the year round. The same seasons would exist in the same places all the year round, with that at the Equator being the hottest and that in the polar regions being the coldest.

With the earth's axis inclined as it is at 23.5 degrees from the vertical, the amount of radiated energy received from the sun on any one part of the earth's surface is constantly changing with consequent variation in the season and in the length of a day.

Q.—What do meteorologists mean when they speak of the "dew point"?

A. When unsaturated air is cooled to such an extent that it reaches saturation, its temperature at that instant is called the "dew point."

We know that fog, rain and snow result from the presence of moisture in the air. Warm air can contain more moisture than cold air. This means that warm air that is just on the point of saturation will become supersaturated (cannot support any more moisture) if suddenly cooled. The excess moisture condenses into liquid and becomes visible either as droplets or fine mist or fog.

Looking at the definition for "dew point" from another angle, supersaturated air is air which has been reduced in temperature below the dew point.

AEGIS KC4

4 Band Tuning Unit

The most advanced

COIL ASSEMBLY

ever offered in

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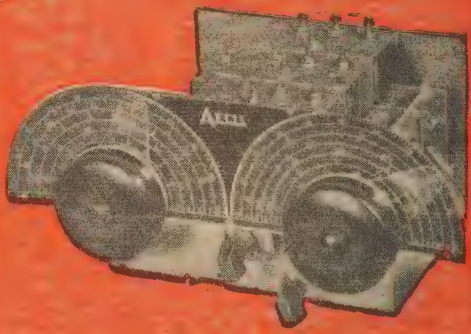


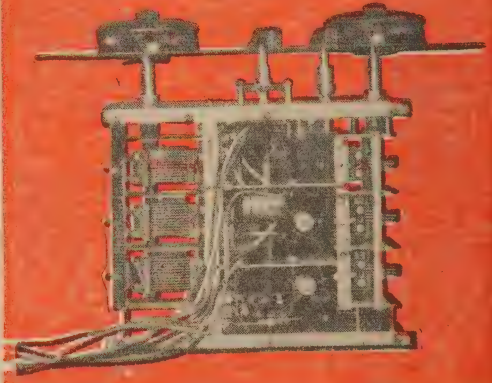
Here's something for the EXPERTS

The new Aegis 4 Band, bandspread tuning unit illustrated at right, is definitely the answer for the amateur who desires to build his own communication receiver. Here are the plain facts of this latest Aegis triumph:

4 Wave Bands.	Band Spread—5 Bands.
550 KC.—1500 Kc.	3.5 — 4.0 Mc. 80 Metres
1500 Mc.— 4 Mc.	6.9 — 7.3 Mc. 40 Metres
	14.0 — 14.4 Mc. 20 Metres
4 Mc.— 11 Mc.	20.5 — 22.0 Mc. 15 Metres
11 Mc.— 30 Mc.	27.0 — 30.0 Mc. 10 Metres

Actually constructed in 3 sub-sections comprising R.F., Converter and Oscillator stages. Finally assembled in one unit, which incorporates Band Set and Band Spread Condensers, together with 2 Slow Motion Drive Assemblies 55/1 and directly calibrated Plastic Dial. Valve Sockets for R.F. (6SK7GT), Mixer (6AC7) and separate oscillator (6SK7GT) stages are already wired. Concentric air trimmers are used throughout, and the 6 section "Oak" Type Switch includes shorting banks for all coils not in use. Aerial Trimmer is brought out to front panel with ¼" shaft. Screws from iron core adjustment in all coils are readily accessible from top of unit, as are also the Trimmer Screws.

For use with the KC4, we recommend Aegis I.F.'s Type Nos. J22 and J23, specifically designed for communication work. A complete set of blueprints for connecting this unit plus a most comprehensive communications Receiver Circuit are supplied with each Kit.



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● Quizzes and stunts, 7 per cent. Sports, 10 per cent.

Variety and vaudeville, 14 per cent.

● Drama, other than crime, especially Westerns, 15 per cent.

This analysis was done by Dr. Dallas Smythe of the University of Illinois, a research expert, and Dr. Donald Horton, of the University of Chicago, a sociologist.

American radio is, practically speaking, entirely commercial, apart from one or two stations like WYNC (owned by the Council of the City of New York).

American television is totally commercial. It is supported by sponsors who buy shows to advertise their products.

Neither in radio nor TV is there any organisation in America corresponding to the BBC or the Australian Broadcasting Commission.

The National Association of Educational Broadcasters has long been asking whether so marvellous a product of the human mind as TV should be devoted only to the propagation of soap-powder plugs.

The NAEB used the two doctors' surveys to back its pleas to the FCC that at least some of the television bands should be set aside for educational broadcasting.

Television is so costly to produce that TV sponsors must, to show a return on their money, slug the watchers with as much advertising as the senses will stand.

The sponsors must also, through necessity, limit their programmes not only to entertainment, but to that enertainment which has the quickest and greatest mass appeal. Drs. Smythe and Horton found that even by bending over backwards to be fair they could not assay TV advertising at less than one minute out of every 10 of entertainment.

Atomic engines

NEW internal combustion engines to be seen in the latest model motor cars overseas, if not in Australia, are claimed to be so improved as to represent possibly the maximum advance likely with this type before turbines make their appearance in land and sea transport.

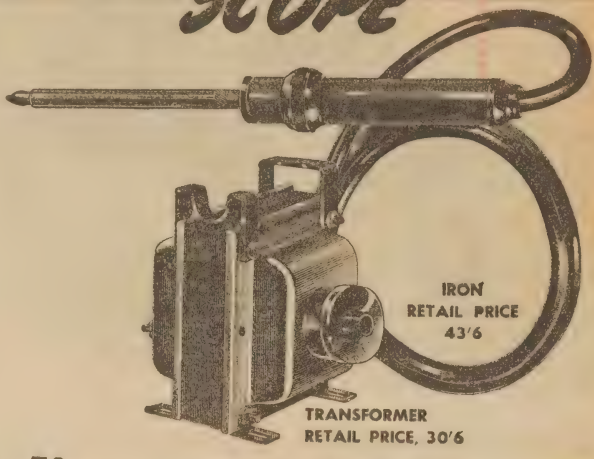
Already this type of engine has been built into experimental cars such as the British Rover which caused such a sensation last year. Although no one is prepared to estimate when a change-over is likely, it seems highly probably that some day it will come.

Even more fascinating are the advances made by engineers in applying atomic power to engines. This development doesn't appear in sight for motor cars, it is true, but for large and powerful installations, some progress seems to have been made.

It is reported that within six months, a new type engine may be ready suitable for driving large plants and drawing on the enriched atom fuel from the factory being built at Capenhurst in England.

The engine would be more costly than conventional types, but would be about five times cheaper to run.

Heating-up Time with SCOPE



IS 70 TIMES FASTER THAN STANDARD SOLDERING IRONS

The Scope Soldering Iron heats up in the amazing time of 6 seconds—any standard iron takes a minimum of 7 minutes. Scope is, therefore, 70 times faster . . . and this represents a big saving in power in more ways than one. Firstly, you do not lose the time or power wasted whilst waiting for your iron to heat-up. Secondly, as with ordinary irons, it is not necessary to leave the iron switched on whilst not in immediate use. The Scope Soldering Iron is operated by pushing the switch ring forward with a light thumb pressure and, in 6 seconds, it is ready for use on the biggest jobs. Thus, the Scope Soldering Iron consumes no power when not in actual use. This also prevents pitting of the bit, and thus avoids frequent cleaning and tinning. Power — approximately 90 watts — dissipated by the Scope Soldering Iron is generated entirely at the bit. Consequently, the transfer of heat is almost 100% efficient. Scope operates from 2.5/6.3 volts A.C. or D.C. and may be coupled to 240 volt A.C. Mains Supply through a suitable transformer. It may also be used from a car battery or 4 volt accumulator. Scope can be used everywhere, anywhere, with the efficiency expected from modern engineered equipment. It is to-day's best soldering iron value. See it, try it—and you, too, will agree.

CHECK THESE FEATURES!

- *Operates from 2.5/6.3 volts A.C. or D.C. or from mains with transformer.*
- *Heats up from cold to ready-for-continuous use in only 6 seconds.*
- *Has an efficiency equal to that of irons rated up to 150 watts.*
- *Weighs only 3½ ounces and is 10 inches long.*
- *Can be used in conjunction with a transformer from A.C. mains or from any suitable car battery.*
- *Has low operating cost—no current is consumed when not in use; no frequent cleaning and tinning of the bit.*
- *Extremely suitable for heavy or delicate soldering—heat is applied only where and when it is required.*
- *Simple to operate — merely press switch ring forward and the iron is hot in six seconds.*
- *Maintenance is simple — elements and replacement tips are fitted easily and without delay. Replacements are screwed in and cost only a few pence.*
- *Fully guaranteed for three months from date of purchase. A maintenance service is available at all times.*

You should see and test Scope for yourself. If you do this, you will agree it is the soldering iron you should and must have. Ring, write or call for illustrated pamphlet and a demonstration.

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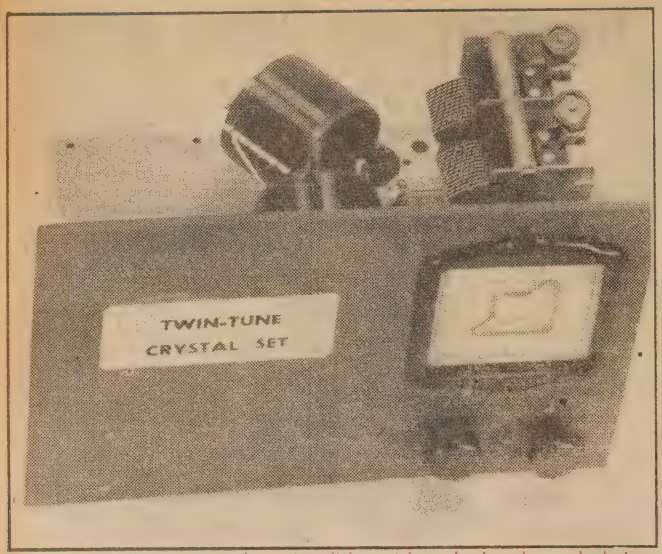


A masonite panel to support the tuning dial escutcheon (and a dummy knob to balance) if a cabinet is not used.

LEARN WHILE YOU BUILD

It's just a month since you received the first instalment of this "Learn-While-You-Make-It" course. By this time you should have completed the Basic Crystal Set and learned several lessons from it. Right then! Start ripping it to pieces, because you're now going to find out all about metal chassis, coupled coils, gang tuning and a few other things into the bargain.

by Philip Watson

THIS crystal set makes a number of departures from the usual run of such simple receivers, both in the circuit and the method of construction.

For the circuit we wanted something which would be an advance over the Basic Crystal Set and, at the same time, provide the builder with more opportunities to learn. On the constructional side we decided that it was time to discard the wooden baseboard and adopt the more modern metal chassis.

METAL CHASSIS

By making the change over at this stage you will have a chance to learn about this method of construction while the circuits are still relatively simple. When the time comes for you to tackle something more complicated you won't have to worry at the same time about problems of metal-work.

Metal chassis fall into two general classes: The ready-made variety, cut and punched to suit a popular design, such as a Radio and Hobbies circuit, and the home-made variety, designed to suit an essentially individual requirement.

The first is made from mild steel, which is not too hard to allow a few extra small holes to be drilled if they should be required. In general, however, it is intended to be used more or less as bought. The second type is usually made from aluminium, since this metal is relatively soft and may be easily cut and bent with ordinary tools.

In order to keep the cost to a minimum, and to avoid introducing too many problems at once, we wanted a ready-made chassis which would suit all the sets to be described in this series, including the mantel model, which we have in mind for your final effort.

After much deliberation we picked on the well-known "Little General" chassis. This is quite able to accommodate all the circuits we have in mind and, being practically a standard line, should not suffer from supply difficulties which often accompany a new design. A cabinet is also available to suit this chassis and will give your set a really professional touch, when the job is ultimately finished.

The performance of any crystal set is necessarily limited, for we have no means of amplifying the signals we receive and the amount of sound in the headphones depends almost entirely on the location and the overall efficiency of the circuit. In an effort to keep the efficiency high we usually have to sacrifice the set's ability to separate stations, or, in other words, the selectivity.

CIRCUIT STUDY

However, we felt that there were probably plenty of cases where signals were strong enough to stand some loss, and the extra selectivity could be used to make available a couple of additional stations.

A study of the new circuit may help the reader to get some idea as to how this has been done. The first part of the set remains much the same as the Basic Crystal Set, the aerial being connected to a tapping near the earthed end of the coil, and the coil being tuned by one section of the gang condenser.

READY MADE TYPE

Now, in the case of the Basic Crystal Set, this is the only part of the circuit which contributes to the separation of the stations and in many cases it is just not sufficient for the job, particularly when two stations are located on adjacent frequencies, and one is much stronger than the other. So, in this set we pass the signals on to a second tuned circuit, where additional filtering or separation is provided before the signals reach the crystal detector and headphones.

The second tuned circuit uses the remaining section of the gang condenser and another coil, which is an exact replica of the first. It is important that these two coils be carefully "matched." This brings us to the question of "tracking," an extremely important subject with an

application to all forms of modern receiver.

Tracking really means that both tuned circuits must respond to the same frequency for any setting of the gang condenser, so that the inductance of the coil and the capacity of the condenser must be the same in each. The two sections of the gang may be regarded as accurately matched, and the problem, therefore, resolves itself into seeing that the inductance of both coils is the same. Further, that any capacitance added to the circuits, such as by wiring, components, &c., is the same in both cases.

COIL TRIMMERS

If the coils are carefully wound on the same size former, with exactly the same number of turns and gauge of wire, their inductances should be quite accurately matched.

This leaves us with the stray capacitance of the wiring as our main worry. It is almost impossible to ensure that this will be of equal value in each section, and it is standard practice to fit small adjustable condensers, known as "trimmers," across each section of the gang so that the total capacity in each circuit may be made equal.

The trimmers are set by tuning in a signal at the minimum capacity end of the dial (gang plates open), and adjusting the trimmers until the signal reaches maximum strength.

We said earlier that the signals were passed from the first tuned circuit to the second, but reference to the diagram will show that there is no connection between these two circuits, at least not in the sense, which we usually understand it. This brings us to another basic principle, that of inductive coupling.

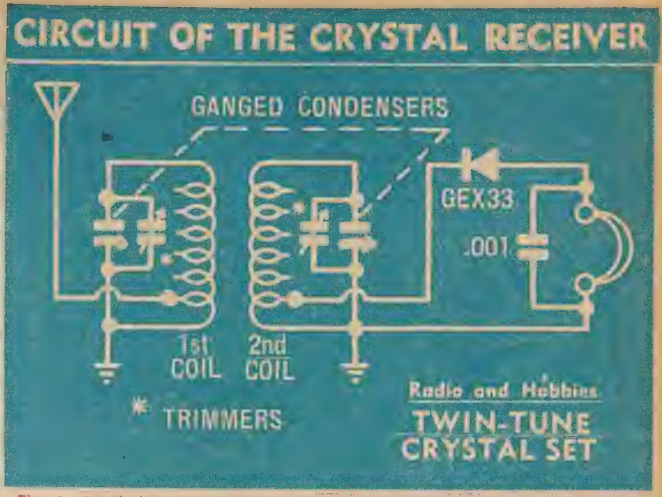
When signals flow through the coil of the first tuned circuit, they produce a magnetic field around the coil, which is a replica, in magnetic form, of the signal currents. If a second coil is brought close to the first one, the magnetic field will induce signal currents in it, thus transferring the signals from one circuit to the other by means of magnetic or inductive coupling.

SECOND COIL

If the second coil forms part of a tuned circuit, tuned to the same frequency as the first, the transfer of signal energy will be maximum at this frequency. Thus, the second circuit contributes to the selectivity as well as the first.

The exact amount of coupling will have quite a bearing on the performance of the set, and, if we can arrange for this to be variable, we will provide a very useful additional adjustment.

Maximum coupling will occur when the two coils are either side by side or end to end, with the least possible space between them. As the distance between them is increased, the coupling falls off. It is also decreased when the angle is altered, reaching a minimum when the two are at right angles. This latter fact is made use of in the set, where it was found more convenient to rotate one coil than to move the two apart.



The circuit is little more complicated than was the original. The coils are the same as for the Basic crystal set, ie, 65 turns of 24 gauge enamelled wire on a two inch former.

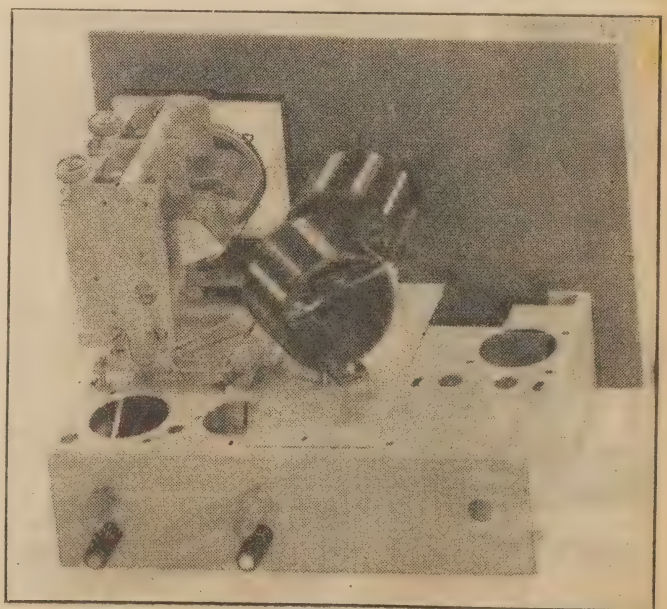
SELECTIVITY

The main effect of varying the coupling is to vary the selectivity and sensitivity. Maximum sensitivity is achieved when a certain critical "coupling" value is reached. The selectivity is also good at this point, and any greater coupling than the critical value spreads the signal until an effect known as a "double hump" is obtained. When this happens, each station appears at two points on the dial and the distance between these points becomes greater as the coupling is still further increased.

This condition is to be avoided, and, for maximum performance, the coupling should be just below the point where two distinct peaks are apparent.

Reducing the coupling will decrease the gain and increase the selectivity until a point is reached where the gain is seriously affected even from strong stations. In between these two conditions a degree of coupling will be found which will give the best possible results for each particular locatioon.

In addition, we may still select various tappings on both the coils

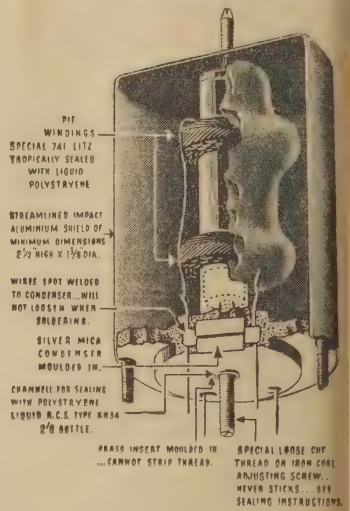


This rear view shows how the coils are mounted on the chassis and illustrates other constructional features mentioned in the article.

Before You Build . . .

your new circuit or your next experimental rig, make sure you have the BEST components available to fit the specifications. You won't have to look past R.C.S. for technical perfection and electrical dependability when it comes to high standard performance.

Cross section of R.C.S. intermediate transformer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and this assists further in the matter of selectivity.

The tapping on the first coil will depend on the aerial to some extent, but, in most cases, the second tap from the earth end will be found to give the best result. The tapping from the crystal detector to the second coil may be varied over a wide range, depending on conditions. When the signals are weak and maximum gain is required, connection should be made to the tapping farthest from the earthed end but, when maximum selectivity is required, a point nearer the earthed end should be tried. In most cases the fourth or fifth tap should give the best results.

This wide range of possible adjustments results in an extremely versatile receiver which, with maximum coupling, appears to be just as sensitive as the Basic Crystal Set. However, it can be made far more selective when conditions permit.

Now for the actual construction: A good idea of layout details can be obtained from the photographs. Since we are working with a metal chassis, assembly will be by means of nuts and bolts rather than the wood screws we used last month. The most popular size bolt is 1-8in Whitworth, usually in brass, round head, and ¼in long. However, other lengths are occasionally needed, and a stock of assorted sizes, with nuts, should form part of every experimenter's kit.

Examination of the chassis itself will show that most of the mounting holes are a clearance size for these bolts but, in some cases, slotted holes have been provided. These are to take care of components from different makers, which may have similar electrical characteristics, but which may differ slightly in size.

Although the design of these chassis takes into account as many varieties as possible, it is not always practical to provide for them all, particularly as new components are continually appearing on the market. It may therefore on occasions be necessary to drill a few extra holes.

GANG MOUNTING

The mounting of the gang condenser may call for some slight modification if the AWA type is used, since the chassis was originally designed for the Stromberg pattern. Although the position of the mounting holes is the same in both cases, there is a difference in the height of the shafts. Since the escutcheon aperture in the cabinet will be ready cut when this item is bought, it is necessary to make sure above all things that the gang is in the correct position to match it.

The Stromberg gang should be mounted so that the plates open to the right, when you face the front of the chassis, with the main frame about an inch from the right-hand edge. The brackets should be fitted so that they turn under the frame of the gang, with the long side facing in the same direction as the moving plates. Mounting directly on the chassis should bring the shaft to the correct height for the cabinet opening.

The AWA gang should be mounted with the plates opening to the left, and having the frame of the gang flush with the right-hand edge of the chassis. These brackets will also need to be turned under, with the long side facing toward the coils.

In order to bring the gang shaft to the correct position it will be necessary to mount the gang slightly above the chassis, and this may quite easily be done with the aid of some ¾in long bolts. These are first secured to the brackets with a nut, and a second nut is used to provide the required spacing from the chassis. Finally, a third nut under the chassis is used to secure the whole assembly. The distance between the chassis and the gang bracket should be approximately 7-16in.

Since the position of the gang will remain the same for all the circuits to come, you may also fit the dial at this stage if you wish. There are not many extras to buy this month, and it is a good idea to spread your financial outlay and get some of the mechanical work done in advance.

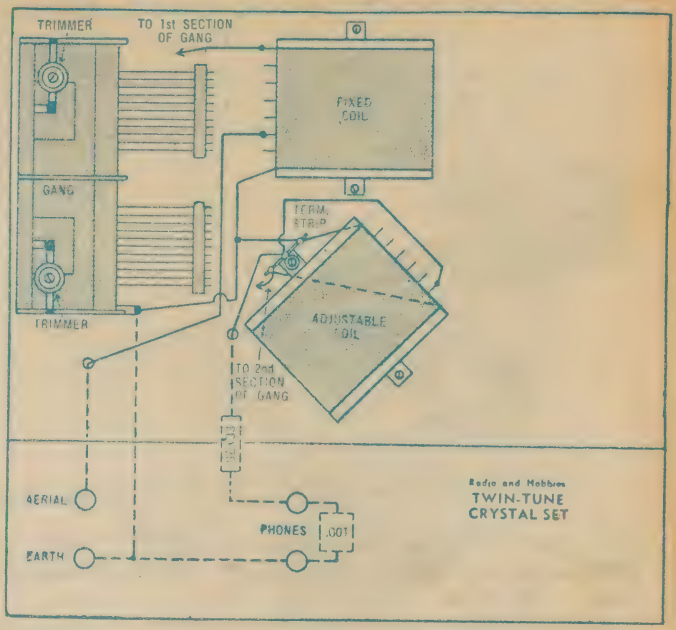
THE DIAL

The dial is quite a simple affair, consisting of a drum which mounts on the gang shaft, and a spindle and bearing which mounts on the chassis. Drive between the two is by means of a cord kept taut with a small spring. The dial glass is mounted in the escutcheon, and this will eventually be fitted to the cut-out in the cabinet. For the time being we decided to fit a panel to the chassis as this enables the dial plate to be used without having to supply a cabinet.

We modified the dial assembly slightly as, by so doing, we were able to simplify the mounting of the gang. The original design called for the cord drive from the spindle to be picked up behind the bearing, but it proved more convenient in our case to take it from the front of the bearing. To provide a smooth drive and prevent the cord from wandering, we secured a small rubber grommet which was a good push fit on the shaft, and arranged the cord to run in the groove.

The front panel was made from

THE CRYSTAL SET WIRING DIAGRAM



This diagram will help beginners in making up the set.

PARTS LIST

1 Little General chassis.
1 Dial calibrated to suit gang. (Type MK/17A or similar.)
2 Trimmer condensers.
1 Front panel 10" x 7" (Masonite &c.)
5 Strips of punching bakelite 2½" x ½" x 116".
2 Small round knobs.
Small block of wood 2½" x ½" square.
Coil former and winding similar to existing coil.
Small rubber gromet for dial drive.
Nuts and bolts (See text).
Hook-up wire, tinned copper wire (18 guage) solder lugs, &c.

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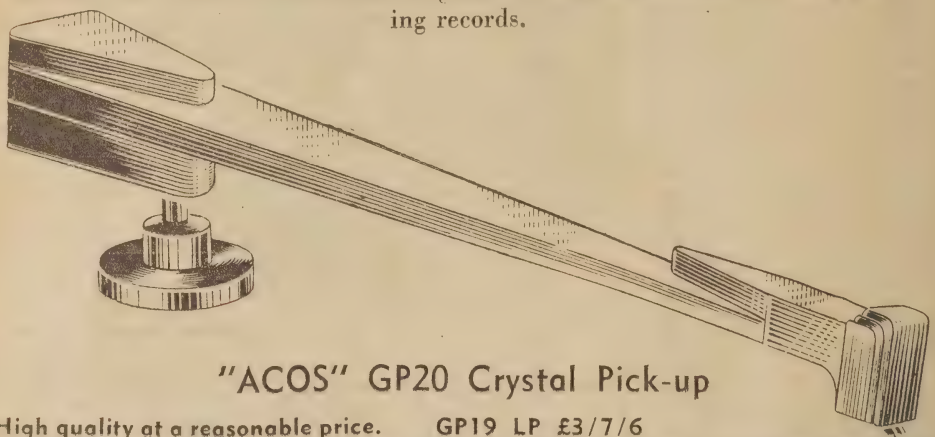

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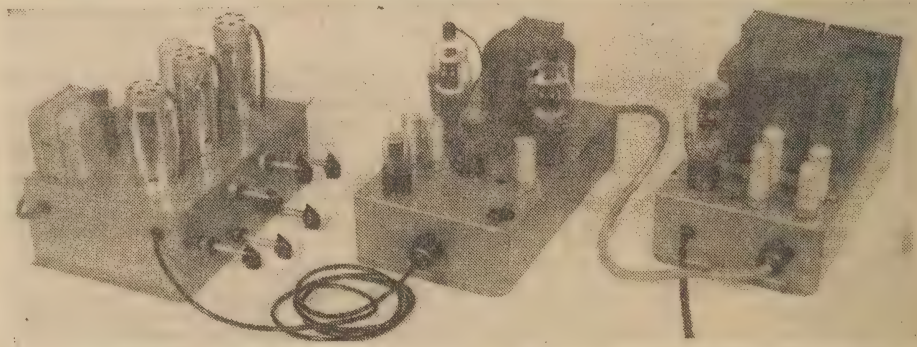

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masonite, but you could use plywood or bakelite, although the latter might be rather expensive in the size panel required. It is not possible to fit the panel against the front of the chassis because of the dial mechanism and, when the set is mounted in the cabinet, there will need to be a clearance of about ⅛" behind the front of the cabinet. The panel was spaced in much the same way as the gang, using 1¼" bolts.

To preserve the balance of the panel we fitted a dummy knob in the position which will eventually be used for an additional control.

The coils are similar to the one you wound for the Basic Crystal Set, in fact there is no real reason why you should not use the one you have already made.

COIL MOUNTING

Some of the large holes already drilled in the chassis were just where we wanted to mount the coils, so an aluminium plate was made to cover this portion until such time as we use the more compact commercial coils. This plate measures 3" x 2½" and the general location of it may be seen from the rear photograph. Incidentally, the rear left hand corner of the chassis will have to accommodate a transformer while these coils are still being used, so make sure that you do not encroach on this area.

To mount the fixed coil we used a small block of wood about 2" long by ¾" square to raise it above the level of the chassis. A strip of aluminching bakelite ½" wide and 2" long fits inside the coil former and clamps it to the wooden block, being held in place with a 1¼" bolt at each end. This bolt goes right through the wooden block and is used to mount the whole assembly on the chassis.

MOVING COIL

The mounting for the moving coil uses three strips of punching bakelite similar to that just described. The coil former is held between two of these, while the third is pivoted in the centre on a 1¼" countersunk bolt. All three are bolted together at each end, so that the whole assembly rotates on the bolt. This is mounted on the chassis and the height of the coil adjusted to match that of the fixed coil.

The wire with which the coils are wound is not flexible enough to stand the bending which would be entailed in the rotation of the coil. To overcome this, we fitted a three way terminal strip under one of the former clamping bolts and connected the coil wires to these. Flexible leads connect from these points to the various parts of the circuit.

The wiring is very little more complicated than that of the Basic Crystal Set, and with the aid of the wiring diagram you should have no difficulty in following the circuit.

The crystal detector is the GEX33, and this is mounted under the chassis on a small terminal strip. We did

(Continued on Page 71)

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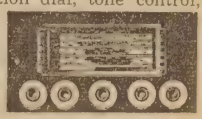

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Z 962-1	25/5	20/200	100	1000
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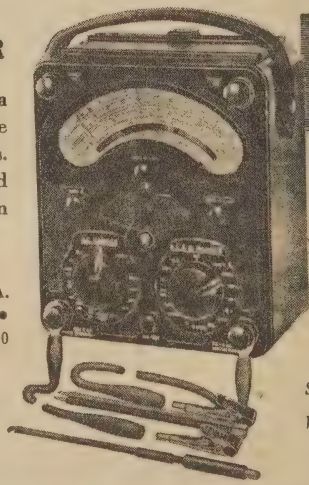

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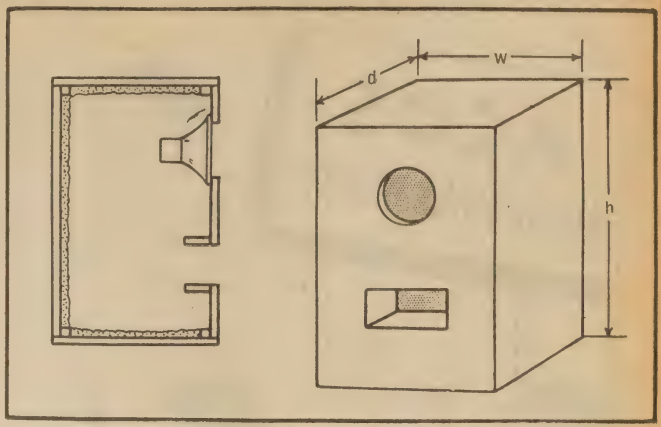
A SUMMARY OF VENTED ENCLOSURES

THE vented enclosure is popular for both home and professional work because it combines good qualities as a baffle with simplicity of construction. The results available in the home from a good twelve-inch speaker and a suitable enclosure cannot easily be bettered by any other system.

Physically, a vented enclosure is simply a large, well constructed box, lined internally with some absorbent material and carrying on one face a cutout for the speaker together with an open port or vent pipe.

Acoustically, it is a form of Helmholtz resonator, with properties which should ideally complement those of the speaker with which it is used. The basic theory may be summarised as follows:

All moving coil speakers exhibit some resonance effect in the bass register. This results in accentuated output over a small band of frequencies with, in most cases, a fairly rapid cut-off below the resonant frequency. If the resonance peak is accentuated, as in a poorly designed speaker, it has the effect of imparting a "one note bass" characteristic to the reproduction.



Big attraction of the vented enclosure is its simplicity coupled with its effectiveness as a baffle. The throat behind the vent may be included as part of the design, if working from the basic formulas given in the article.

Questions about vented enclosures — their size, design, construction &c. — are posed very frequently through the query service. This article summarises the technical information which has been published to date and gives sufficient working data for the home constructor.

Electrically the speaker can be likened to a series-tuned circuit with properties of capacitance, inductance and "Q" factor, which together determine the position and definition of the peak in the frequency range.

RESONANT PEAK

In a well designed system this so-called "Q" factor may be fairly low, and likewise the height of the peak, being limited by the characteristics of the speaker itself and the electrical loading imposed on it by the amplifier. Important though these factors are, however, they seldom solve completely the problem of bass resonance.

There are two obvious methods of dealing further with the problem. The first is to provide an infinite baffle system or a horn which limits the resonance effect by sheer acoustic loading on the cone. The second method is to mount the speaker in a deliberately resonant chamber which exhibits precisely the reverse characteristics of the speaker. This is where the vented enclosure enters the picture.

An enclosure of this type exhibits a resonance effect between the volume of the enclosed air and the mass of the air in the port or vent pipe which provides the output coupling.

The two properties may be likened respectively to the capacitance and inductance of an electrical tuned circuit, the resonant "Q" being determined by the amount of damping material inside the box and across the vent.

Furthermore, the enclosure simulates the properties of a parallel tuned circuit and is therefore opposite to those of the speaker.

If, by proper design, the enclosure resonance can be made to coincide with the speaker resonance, the two effects tend to cancel out. The cancellation may be made more nearly complete by varying the amount of damping in the box or over the port and so matching the "Q" of the enclosure to the "Q" of the speaker cone assembly.

AMOUNT OF DAMPING

It follows that a speaker/amplifier combination having a well damped resonance characteristic would call for a heavily damped enclosure. This damping is useful, furthermore, for suppressing internal reflections at higher frequencies where the enclosure is non-resonant.

The technique lends itself best to 12-inch speakers (or larger), which can be expected to exhibit a bass resonance in the region from 50 to 80 cps. Operation of the system will then ensure good response to approximately one-half the resonance figure, being equivalent, in round figures, to a 30-40 cycle cut-off.

With smaller speakers, having progressively higher resonant frequencies, the cut-off frequency also rises and may reach what is considered an unsatisfactory figure. In this case there is much to be said for sacrificing the cancellation effects of an accurately designed enclosure and deliberately exaggerating the volume to bring about a second resonance at a frequency much lower than the speaker would naturally be able to generate. The effect, when this is done, is naturally quite different from that envisaged by the original scheme.

In general, readers who are keen to obtain good quality would be well advised to purchase a 12-inch speaker with as commendable characteristics in other directions as possible. Fortunately or otherwise, depending on the point of view, most of the commercial 12-inch speakers now available have as good middle and top response as their little brothers.

Sufficient information is available nowadays to enable quite accurate calculations to be made of enclosure dimensions provided one can handle "medium-weight" formulas and the characteristics of the particular speaker are known. If simple test gear is available to "tailor" the finished cabinet so much the better.

RULE-OF-THUMB

For those less well equipped it is possible to work to a simple rule-of-thumb which will at least avoid the possibility of a glaring error. Fortunately, the design of modern speakers and amplifiers is such that the resonance peak is usually moderate and the effect of an enclosure which is even approximately correct can hardly fail to be beneficial as compared with flat baffles or open-backed cabinets.

The simple rule-of-thumb is to make the enclosure volume in cubic feet equal to the nominal radius of the loudspeaker in inches—or half the nominal diameter. Thus a 12-inch speaker would require a six

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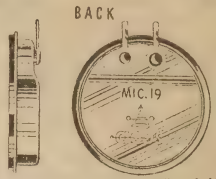

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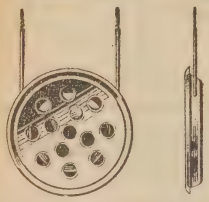

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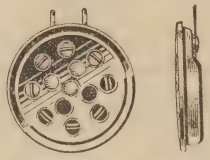

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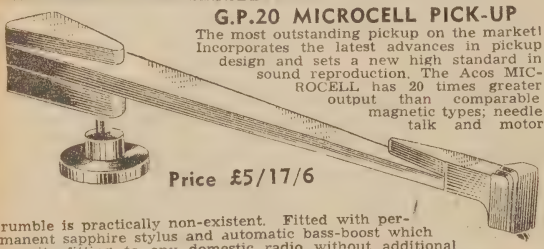

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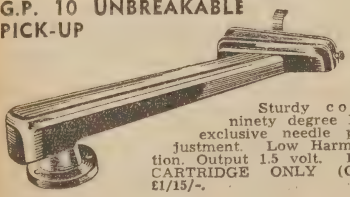

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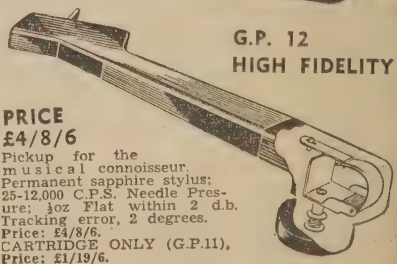

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SOLE AUSTRALIAN REPRESENTATIVES

SOME TYPICAL SPEAKER FIGURES

Nom. spkr. Size (in.)	Approx. Displ (Cu. in.)	Approx Cone Area (Sq. in.)	Approx. Res. Freq. (cps.)
6	10-20	20	150-200
8	30-60	38	100-150
10	70-140	60	70-100
12	100-200	85	60-85
15	200-400	115	40-65

Typical figures for use with the bias formula. Heavy speakers in any class would probably exhibit maximum quoted displacement and lowest quoted cone resonance. Light speakers would be the reverse.

cubic foot enclosure, and so on down the scale.

A similar rule-of-thumb sets the port area at 0.8 times—or just over three-quarters—the area of the actual loudspeaker opening. Formulas covering the area of a rectangle and a circle are well known.

It will be found that the above rule-of-thumb treatment gives an enclosure size which is near optimum for an average 12-inch speaker but scaled up somewhat for the smaller sizes. The effect is to gain a much-needed extension to the bass response rather than to effect complete cancellation of the resonant peak.

EFFECT OF THROAT

The above dimensions assume that the vent is a simple opening in the cabinet front. For purposes of experiment the resonance of the chamber can be lowered by fitting a tube inside the vent opening, as indicated by the sketch. The opposite effect, that of increasing the resonant frequency, is most easily obtained by placing bricks or blocks of wood inside the enclosure.

For those who prefer the accurate approach a basic formula derived by Lord Rayleigh is:

$$f = \frac{c}{2\pi}\sqrt{\frac{A}{V\,(L + \tfrac{1}{2}\sqrt{\pi A})}} \qquad (1)$$

Where

f is the resonant frequency in cps.
c is 13,560 (Vel. sound, in./sec.).
A is port area in sq. in.
V is effective internal volume in cu. in.
L is length of the port in inches.

Transposing and simplifying the expression gives;

$$V = \frac{4.657 \times 10^4 A}{f^2\,(L + .886\sqrt{A})} \qquad (2)$$

Analysing the formula "f" may be available as a published rating. However, it can be observed by operating the speaker without a baffle and either from a high impedance amplifier (e.g. pentode without feedback) or with a resistor in series with the voice coil having a value two or three times the voice coil impedance.

Run over the bass register with an audio generator and note the peak in acoustic output. If the peak is not clearly defined, a sensitive VT voltmeter across the actual voice coil terminals will generally show an increased reading at resonance.

The port area "A" should be large enough to radiate efficiently but not so large that it pushes up the necessary cabinet volume to prohibitive limits. As a rule, "A" is kept to between 0.75 and 1.0 times the area of the speaker opening, the actual shape being set to give the most pleasing effect to the eye.

Detailed analysis of the port length is difficult to find, but it appears that it should not be more than a small portion of the total cabinet depth. The usual limit is about 4 or 5 inches, minimum depth occurring when the port depth is equal to the total thickness of the cabinet front, plus any possible absorbent packing.

Within these limits, increasing the port length has an equivalent effect to increasing the enclosure volume.

It should be noted that the volume, as calculated, must exclude the space occupied by the speaker itself, by bracing timbers, by absorbent packing and the throat. Allowance for these items must be made by suitably increasing the internal and therefore the external dimensions. A table published in the US by D. W. Worden gives the approximate values for speaker displacement, cone area and likely resonance limits for speakers of various nominal diameters.

APPROXIMATE FIGURES

Nominal Speaker Diameter	Volume of Box (Cu. ft.)	Area of vent (sq. in.)
8	4	30
10	5	45
12	6	76
15	7.5	115

These are approximate figures derived by the rule-of-thumb method. No throat would be employed.

The cone area quoted is gross ar based on the slant height of cone.

The exact shape of a cabinet is critical, the important point being see that none of the dimensions a proach a quarter-wave at a f quency near resonance or, ideal at a frequency where the absorbe material is ineffective. Extrem long cabinets should therefore avoided, the most effective a strongest shape actually being cube.

Unfortunately a cube is also one the most ugly shapes and acceptab proportions are in the approxima ratios of depth (d); width (w height (h) as 1; 1.7; 2.5.

VENT POSITION

The exact position of the vent relation to the speaker is not critic since the phase relationship betwe vent and speaker radiation is go erned by internal resonance effec rather than by path lengths.

For the sake of appearance, it conventional to group the two ope ings fairly close together and to cov them with a single piece of fabri The fabric should preferably be open weave to avoid high frequen absorption in front of the speak cone and also excessive dampin effect across the vent at the low fr quencies.

It is very difficult to assess accur ately the optimum degree of interna damping, since it depends on man unknown factors. Materials like ha felt are commonly used but the damping qualities are only mediocr Therefore, to ensure adequate dam ing, it is preferable to line all insid faces of the enclosure, except per haps the front, which is a broke surface anyway.

Recent experiments in Englan have shown the benefits of stretchin a damping cloth horizontally acros the centre of the cabinet and actin upon the internal reflections at th point of highest velocity.

Finally, the enclosure must b made of thick wood, preferably 1 inc solid stock or ply. All joints an corners must be airtight and rattle free, while large flat areas whic might tend to give drumming effect should be cross-braced for additiona rigidity.

We have noticed

● That some readers are still planning to build the original "Handie Talkie" receiver, which used two IF stages and five valves in all. The design was centred around the earliest of the English midget coils and IF transformers. With modern high gain components, the 5-valve circuit will be unstable. The 4-valve version of the circuit was printed to suit the more modern components.

● That many readers look with suspicion on the midget tubes, reasoning that they could not possibly be as robust as the large types. It is true that the pins are more frail and care is necessary on this score but the inside "works" are generally more rigid, because they are bette supported by the short connectin wires.

● That impossible things are ofte expected of a noise limiter. Funda mentally, a noise limiter can onl remove loud crashes which exceec the equivalent of 100 pc modulation A constant background hiss or low "frying" noises, as from faulty power wiring, cannot be eliminated from an AM system.

● That we are frequently asked for circuits and information about commercial radio receivers. Information of this type is not filed in our office. You must ask the manufacturer or his representative or look up a commercial circuit manual as used by servicemen.

Here's your answer, Tom!

We must admit that we are sometimes inclined to smile at some of Tom's queries when first they confront us in the morning mail. But after a little thought, some of the questions are not as irrelevant as they appear and we are able to bring to light some interesting information in answering them. So keep the letters coming—we rely on them to keep in step with your problems.

FOR instance had Tom not asked, we would not have realised that he was puzzled about "enamelled" wire. We probably asked a similar question ourselves, when we were Tom's age, but it's just the sort of thing we now take for granted, as being understood by everybody.

What is enamelled wire? I often see references to it in your technical articles.

Well, you see, Tom, it's like this!

When we wish to make up coils, chokes, transformers &c., perhaps hundreds of turns of fine wire have to be wound into quite a small space. The only sensible way to do this

and prevent the turns shorting across is to give the wires an outside coating of insulating material.

But what? Paper, rag, paint, wood, wax, chewing gum? Well, after eliminating all the stupid suggestions, manufacturers have got down to using layers of silk or cotton thread, a layer of paper or a layer of enamel.

The practice has become so universal nowadays that it is hard to imagine a piece of radio equipment which does not depend on insulated wire for its efficient operation.

Paper insulation appears to find favor with the PMG's department for telephone wiring, although it is unsuitable for most radio applications. Double layers of silk or cotton thread wound in opposite pitch are frequently used but enamel appears to be most generally suitable material, especially for very fine wires.

Where more than usual strain is to be placed on the insulation, it is not uncommon to have a layer of enamel covered by one or two layers of cotton. Apart from the fact that enamel is a good, tough insulator, it has the advantage that it keeps moisture away from the metal.

Books such are Radiotron Designers' Handbook include tables to show how much space is occupied by bare copper, enamelled, double cotton covered wire &c. so that you can predict the winding length of a coil with a given number of turns.

Note that the gauge quoted is always the size of the actual copper conductor.

I am thinking of building a crystal set and the parts list specifies four terminals. What type would you suggest and what are terminals, anyway?

Despite what it says in the parts list, Tom, you could actually forget about the terminals and the signals will be just as loud. In other words, they are electrically unimportant.

But then the same is true of the chassis in a crystal set. It would work quite well with all the components arranged on the kitchen table, provided the wiring was correct.

You see, Tom, just as the chassis is a convenient means of holding all the parts firmly together so the terminals are a convenient means of making connections external to the set. Without them it would be necessary to run aerial and earth wires, headphone leads &c. directly into the wiring of the set, making it a major operation to disconnect any one of them.

Terminals appear in many varieties., depending on whether they are to be used for electrical, radio, telephone work, &c. If they are to mount on a bakelite panel, or such like, almost any type of terminal can be used conveniently. With a metal panel, however, or a metal chassis, the problem of insulation comes into it.

The terminal either has to be insulated with bakelite washers or (if you are wise) you will select a type which has the self-insulating kind of mounting. Most of the pretty-pretty moulded terminals you see in radio shops these days are of this type.

Such terminals have a central metal rod which has a small hole drilled at one end and is threaded at the other. This central rod is carried in a plastic bushing which forms the body of the terminal and, in use, it is locked against the panel with washers and a nut.

The incoming wire runs through the small hole at the front of the terminal and is held in place by a small spring and sliding bush. The wire running away from the back of the terminal is soldered to a lug placed underneath the locking nut.

What the hec, Tom? It sounds a lot more complicated in words than it really is. Just get one of the things have a look for yourself.

For the earth of my radio I have attached a wire to a piece of tin. Is this good or not?

A tailor could hardly be expected to make a suit for a man on the information that he had blonde hair. Similarly without knowing where the piece of tin is placed we are not in a position to say either yes or no.

Whatever the use of the earth wire, the idea is to make an effective connection with the ground. If the piece of tin to which you refer is buried deeply in the ground, or wrapped around a water pipe, then it would be in order to use it.

Otherwise solder a piece of heavy gauge wire securely to a sheet of tinplate or galvanised iron and bury it in the ground, preferably where it is damp. The bigger the metal sheet, the better the earth is likely to be. A kerosene tin folded out flat will serve admirably until it finally rusts away.

Just by the way, we have noticed that pieces of metal embedded in brick walls sometimes show very good conductivity to earth while at other times almost an open circuit. It seems

to be connected with the amount of moisture in the air. If you live in Sydney, such an earth would work well 90 per cent of the time!

When I touch the aerial of my radio it plays louder. Why does this happen?

This is quite normal, Tom, and does not indicate that your radio is freakish in any way. Your body is a partial conductor of electricity so that when you touch the aerial terminal the effect is something the same as that of connecting a lump of metal the same size and shape as yourself to the set.

You are probably using a fairly small indoor aerial, the pickup capabilities of which are limited. If you were to change to a large and efficient outdoor aerial the effect would probably not be noticeable, since the signal delivered by your body "aerial" would be small in comparison to the signals brought in by the aerial proper. This is especially true if the receiver is equipped with an efficient AVC system.

Modern superhet receivers are often extremely sensitive and work quite satisfactorily despite an inefficient aerial. For optimum results the good aerial is still required.

All of which brings to mind the story of the Scotsman who decided he would save on the cost of wire by holding his finger on the aerial terminal. The story has a sad ending, however, for he later committed suicide when he found his body could receive Irish programmes along with the rest.

I recently purchased a set of miniature coils and IF transformers which instead of the usual centre mounting bolt are provided with a pair of lugs formed from the shield can. How should these be mounted?

As far as we can see, the best way to handle these is to drill a couple of extra holes for the lugs, pass them through the chassis and bend them over. The lugs can then be soldered to the chassis to make a firm job.

Of course, it will be necessary to scrape away some of the laquer from the chassis and clean it thoroughly to ensure a good joint. The amount of heat required is beyond the capabilities of the average electric soldering iron and a fairly large copper bit which can be heated on a gas ring will probably be required.

Alternatively, one of the new quick-heating irons should be able to do the job.

Wipe away all the excess flux, using some methylated spirit if necessary and be sure to dab some grey laquer over any exposed metal. If you don't it will rust within a week.

Where exactly is the signal detected in a superhet, and how is it done? I notice there doesn't seem to be any resistor and condenser coupled to a grid, as in a TRF set.

Actually, Tom, the signal in a superhet receiver is detected twice.

The second detector, which recovers the modulation from the IF signal, most nearly resembles the leaky grid detector in a regenerative receiver with which you appear to be familiar.

In the case of a regenerative receiver, the detector is usually designed around a triode or a pentode valve but the detector is still essentially a diode formed by the grid and cathode of the same valve. The amplifying seotion of the valve is directly coupled to the detector because of the common element.

The detector load resistor and associated filter condenser may be connected between the top of the tuned circuit and the diode plate (the grid) or between the bottom of the tuned curcuit and the cathode without essentially effecting its operation.

However, in the case of a regenerative receiver it is usually convenient to earth the rotor plates of the tuning condenser so that the circuit is simplified if the load and filter condenser are connected between the top of the tuned curcuit and the grid of the valve.

With the second detector of a superhet, the tuned circuit is usually self-contained and, futhermore, it is necessary to couple the audio to an external circuit so that it is more convenient to place the load between the lower end of the tuned circuit and the cathode.

This, Tom, is why you were not able to recognise the grid leak and condenser in the superhet circuit.

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AC3	17	7	9	£1 19 6
AC4	17	10	9	£2 15 0

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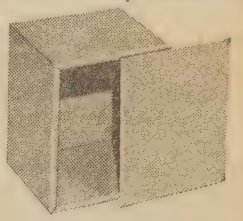

This line of Cabinet is for housing electronic equipment of all types. It has a fixed back and removable front. Color Grey.

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MC81112	8	11	12	19/-
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MCSF796	7½	9	6½	12/6
MCSF7116	7½	11	6½	14/6
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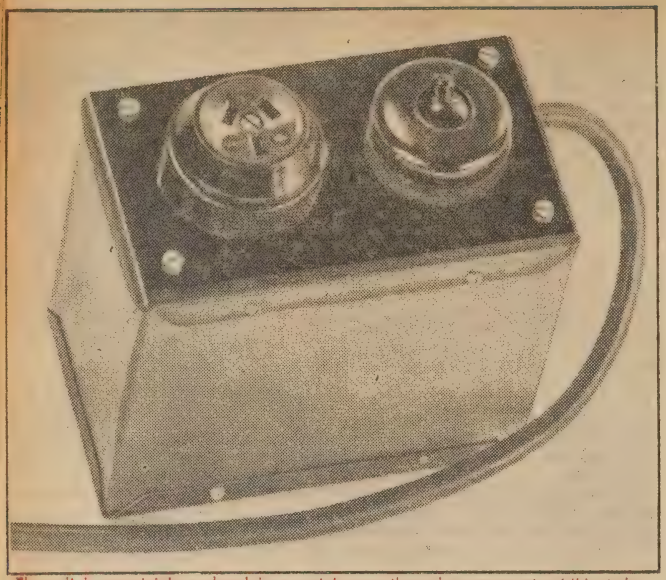


The unit is completely enclosed in a metal case, the only components visible being a power switch and a socket from which the 240 volts AC is drawn.

arrangement of the two 6 volt primary windings, as indicated in the circuit diagram.

In a unit such as this, a lot of design work centres around wattage rating. Being primarily intended to operate mantel-type radio sets, we can agree on a power loading around the 40 watt mark.

WATTAGE RATING

As the power transformer itself can have quite a bit of reserve as far as wattage rating is concerned, the main limitation is in the current-carrying capacity of the dual-interrupter contacts. An excessive load may "gum up" the contacts. The wattage limit quoted is in keeping with the capabilities of the 6 volt type.

The 12 volt type of interrupter has greater leeway because of the reduced contact current for the same wattage load.

In the case of mantel sets, it is seldom that the valves are operating at full rating. Consequently, we can make a general statement that the average mantel set will have a power consumption rating between 30 and 50 watts.

The consumption of many console sets will also fall within these limits but the larger ones will go well beyond. However, the operation of a large console set was not envisaged and, anyway, who would want to carry a console set in a car?

AC SUPPLY FROM BATTERY

Here is a simple, easy-to-build unit which makes it possible to operate a conventional mantel radio from the car battery. No modifications whatever are necessary to the set, apart from providing it with an aerial outside the car. The drain is fairly heavy—about 7 or 8 amps on full load—but that won't be any bother if you operate the unit discreetly.

THE same objection applies to all battery-operated equipment whether it be a portable set or a car radio and, the heavier the drain, the more restricted must be the periods of operation. However, there's another side to the story.

There must be hundreds of motorists, who, periodically find themselves on the beaches or out in the never-never at the very time when they want to hear a special race broadcast or some such item. Unless they have a portable set or a car radio they simply have to go without and, what makes it worse, there's generally a perfectly good mantel set sitting idly on the shelf at home.

USE IN BLACKOUTS

And what of the radio serviceman who, during power "blackouts" in the city, is virtually reduced to "twiddling of thumbs" waiting for the power to come on again.

If, in these and other cases, an alternative source of power could be had cheaply, it would, indeed, be a great boon.

This little gadget provides just that answer for it is a portable AC power outlet point, which is independent of the AC power mains for its operation. All that is required is a 6 volt or a 12 volt accumulator.

The unit consists of a dual-interrupter vibrator unit operating in conjunction with a vibrator transformer and providing, at a standard 3-pin flat power socket, 240 volts, 100-cycle AC.

Its operation from a 6 volt or a 12 volt accumulator is determined by the type of dual-interrupter unit. The transformer is suitable for use with either dual-interrupter type, the necessary change being made by the

by Raymond Howe

USES

In general, this unit was intended to operate radio sets and allied test equipment having a wattage consumption within the limits stated. The operation of other 240 volt AC equipment will depend, apart from the wattage rating, on their behavior with 100-cycle near-square wave excitation in lieu of the normal 50-cycle sine wave input.

The circuit diagram of the unit is the essence of simplicity. There are two major components and four minor ones, apart from the switch and socket.

The transformer has been designed to cope with either 6 volt or 12 volt input by the simple arrangement of having two primary windings, which are virtually connected in parallel for 6 volt operation or in series for 12 volt operation.

The use of two separate primary windings for the 6 volt operation has the advantage of better load distribution on the interrupter contacts than when the contacts are directly paralleled and coupled to a single winding.

This point is not so important for the 12 volt operation because of the lower current flow for the same wattage.

SECONDARY

The secondary winding of the transformer has been arranged to provide a voltage of the order of 240 volts under near-maximum loading. The output voltage under lighter loads will be higher than this figure, rising to around 300 volts for the "no load" conditions.

This order of regulation is fairly good when all factors are taken into account. Firstly, there is the DC resistance of all wiring in the primary circuit from the battery to the interrupter contacts. There is a practical limit below which it would be awkward to go.

Secondly there is the inevitable DC resistance of the transformer windings and the leakage reactance between them. Another very important factor is the selection of the optimum value for the buffer capacitance. A poor selection can upset the regulation very drastically.

BUFFER CONDENSERS

With the particular transformer used in the prototype unit, the buffer capacitance worked out to the convenient value of .05 mfd. To remove any possibility of breakdown of the buffer capacitor, the required value of .05 mfd was made up by connecting two .1 mfd 600 working volt capacitors in series across the winding and taking the centre-tap of these capacitors to earth. This gives a working voltage for the composite buffer capacitor of 1200 volts and, since the junction of the two capacitors is earthed, a RF bypassing is obtained on the outgoing leads.

When the load on the unit tends to be on the light side, it may be necessary to lower the input or output voltage so that the figure of 240 odd volts is obtained. However, more of this anon.

When reading the output voltage from this unit, it is wise to bear in mind the probability of error in voltage reading with the standard multimeter. The point is that the meter deflection varies with a wave-shape, which is near-square in this case compared with the smooth sine wave shape of the normal AC mains supply.

HT LINE

Where the input voltage is critical, as with some item of test equipment, the best procedure would be to measure the rectified DC on the tester circuits, when operated from the mains and then to set the input voltage from the battery/AC power unit until the rectified DC is the same. The corresponding reading on the AC volt-meter should be noted for future reference.

In the case of a radio set, there is a good deal of leeway in this respect and the reading taken on the AC range of a multimeter can be considered as being near enough to the correct operating voltage. Actually, the rectified DC in a set will be a few percent lower from the 100 cycle source for a given reading of a-c input.

Completing the story of the circuit diagram, you will see that the incoming leads from the accumulator are not marked with any polarity because it doesn't matter which way the leads are connected, when dealing with AC output from the unit.

The incoming leads are identified as "active" and "chassis" to conform with the arrangement of an accumulator in a car. The "chassis" lead is connected to the common earth point within the unit while the "active" lead is taken through RF filtering and thence via a switch and a fuse to the centre-tap of the transformer primary.

This switch is the usual 10 ampere house wiring switch and is mounted alongside the usual house wiring 3-pin flat power socket on one of the removable lids of the standard vibrator case, the combination having the appearance of the normal power-point.

The fuse within the unit is optional provided that the "active" is fused externally on its run to the battery or to a distribution point behind the dash of a car. The idea of the fuse is to prevent the contacts of the dual-interrupter welding together if they happen to stick momentarily during use.

The RF choke and the .25 mfd tubular capacitor form an RF decoupling network to prevent "hash" currents developed within the unit from appearing on the leads to the battery.

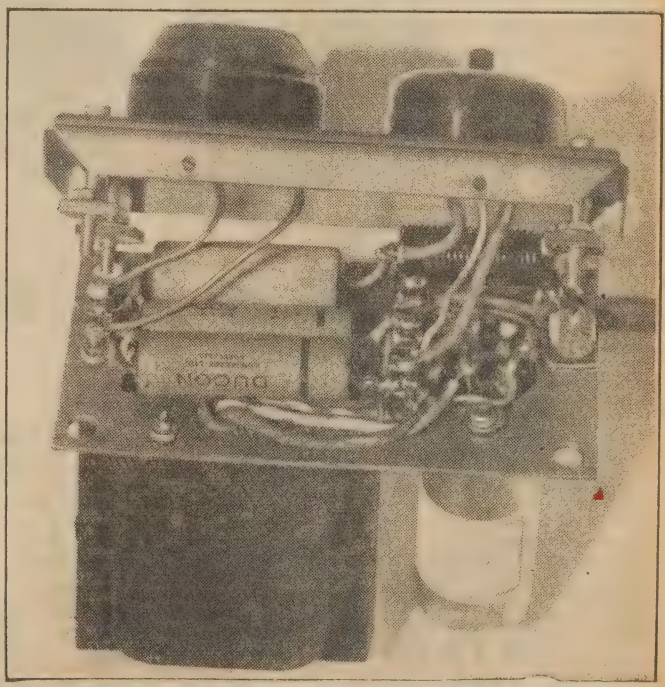
In our original unit, the RF decoupling was so effective that it was possible to wrap the aerial lead around the leads to the battery without any evidence of "hash" interference.

LOW "HASH"

We applied to this unit the constructional technique employed in all other vibrator power supplies described in the magazine. The essential feature of this technique is to mount all components on an internal mounting plate, which is then insulated from the main case. All earth points of the wiring of the unit are, as far as possible, taken to a common earth point on the internal mounting plate, this point in turn, being connected by a short lead to a single point in the main case.

Such an earthing arrangement prevents "hash" currents from flowing around the outside of the main case and, as a result, this case is quite "cold" to RF.

It is important in the interests of



Parts are few. Visible here are the vibrator, the power transformer, the buffer and filter capacitors and the RF choke.

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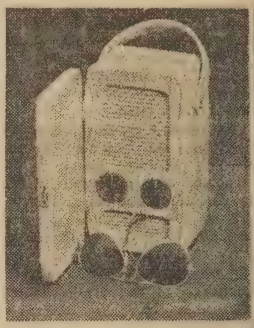

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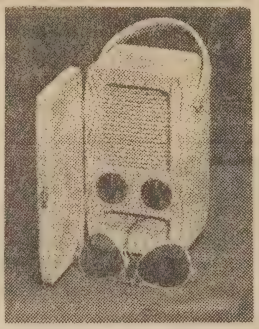

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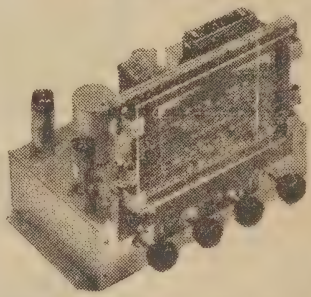

A miniature AC radio receiver. Chassis fitted with pick-up Terminals. Ideal for a portable outfit. Fully described in Radio and Hobbies, January 1951. Size 8¼" x 5" x 2½"

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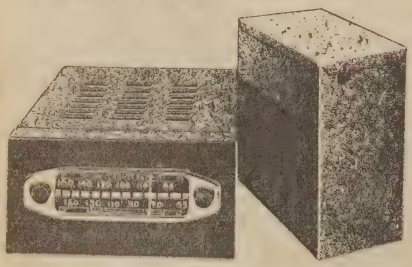

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"hash" elimination that the chassis of the set be connected to the common earth point within the unit. You will note that the "earth" pin of the 3-pin flat power socket is wired to this earth point so that, by the use of 3-wire flex to the set, the chassis of the set and the unit are connected. Join the green wire of the flex to the set chassis at one end and to the "earth" pin of the set power plug at the other.

CONSTRUCTIONAL

On the constructional side, there are a few points worthy of mention. In the first place, the case housing the unit is the same as that used for the vibrator supply of the Karset of the May, 1949 issue. This has become our standard vibrator case.

You will probably find it necessary to make up the internal mounting plate. It is merely a matter of cutting a piece of 16 gauge metal to the dimensions of 5¾ inches by 3¼ inches and drilling it to take the mounting lugs of the transformer, the 6-pin socket for the dual-interrupter and three 1/8 inch holes for the two tag mounting strips and the clamp for the battery cable.

Drill a 5/16 inch hole in each corner of the plate to take the 3/16 inch mounting bolts and the associated insulating material.

You may have your own ideas of insulating the internal mounting plate but make sure that it will withstand vibration if it is to be mounted in a car. In our case, we made up eight square washers from 1/8 inch bakelite sheet which were placed on either side of each hole with 3/16 inch metal washers between the bakelite and the securing nuts. The 3/16 bolts are located centrally in the 5/16 inch holes by packing around with a short length of small-size spaghetti before the securing nuts are screwed up.

The parts list gives the size and quantity of all bolts, nuts, washers and rubber grommets used in the construction of the unit. Two of the ⅜ inch by 1/8 inch bolts are used to secure the switch to the case lid and the other two are used to hold the 6-pin socket.

SOCKET MOUNT

This socket is rubber-mounted by passing the bolts through the 1/8 or 3/16 inch grommets set into the ¼ inch holes on either side of the 1 1/8 inch socket hole in the mounting plate. Four 1/8 inch metal washers are used with each of these two bolts, one on each side of the grommet and one on each face of the socket plate. The socket is raised by these bolts from the mounting plate by some 3/8 inch so that the socket pins protrude through the large hole.

Two of the ½ inch by 1/8 inch bolts are used to mount the 3-pin flat power socket. The other ½ inch bolt is cut to about 5/16 inch and holds the cable clamp. Onto the free thread above the nut, a ½ inch length of a threaded insulating pillar is screwed. Into the top of this pillar, a ¼ inch bolt, cut down to a little over 1/8 inch, is screwed with a solder lug under the head. This point constitutes the junction point of the incoming "active" lead and the RF choke.

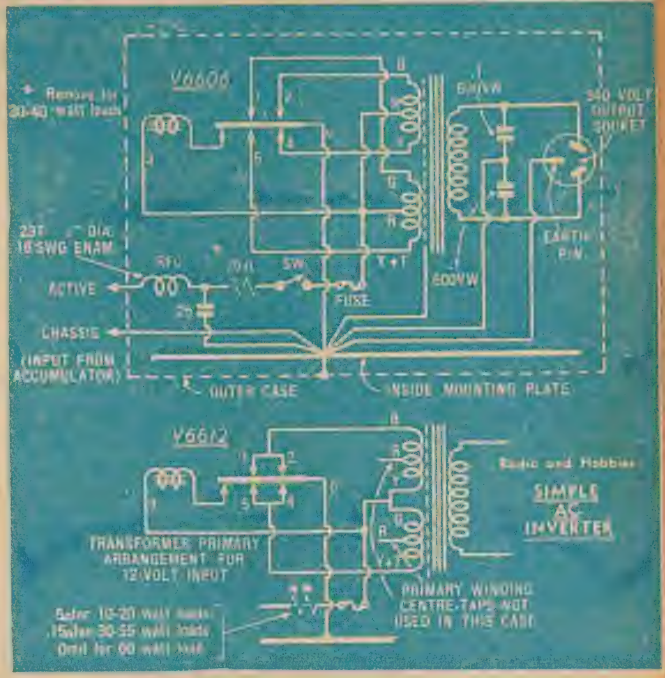
Of the remaining ten ¼ inch by 1/8 inch bolts, eight are used to secure the top and bottom lids to the case and two hold the 3-tag and the 7-tag mounting strips. One of the lid securing bolts will protrude into the case at a point close to the RF choke. To remove any possibility of a short circuit here, trim the bolt down to 3/16 or 1/8 inch.

TAG STRIPS

You will see from the photograph where the tag mounting strips are positioned and how the tags are bent at rightangles to increase the clearance from the case lid. Only four of the tags are used on the 7-tag strip and this could be replaced by a 5-tag size but we stuck to the 7-tag to give a little more clearance between the "hot" tags and the earth tag.

The first step in the actual wiring is to sort out the power transformer leads by the color-code, lay them in place and cut to length. Then carefully remove the spaghetti from each lead for a distance of about ¼ to 3/8 inch and scrape off the enamel coating on the wire. In the case where

CIRCUIT OF INVERTER UNIT



The circuit diagram of the simple inverter. The color coding of the transformer primary leads is that of a Ferguson type. The odd values of resistance shown dotted in the input lead can be made up with a suitable length of an appropriate gauge of enamelled copper wire selected from the standard wire tables.

PARTS LIST

1 Standard vibrator case 6" x 3½" x 5" deep (with top and bottom lids) complete with inside mounting plate 5¾" x 3¼."

1 Piece of ⅛" or 3/16" bakelite, 6" x 3½."

1 Vibrator transformer with two separate 6 volt primary windings, a secondary winding 240V at 30 to 40 watts. (VT146 or similar).

1 Dual-interrupter vibrator unit (type V6606 for 6 volt, V6612 for 12 volt).

1 3-pin flat power socket.

1 10 ampere single-pole switch.

1 .25mfd 200VW tubular capacitor.

2 .1 mfd 600 VW tubular capacitors.

1 6-pin socket, 1 7-tag and 1 3-tag mounting strips.

SUNDRIES

4 1½" x 3/16" bolts with 1 doz. nuts, 4 ¾" x ⅛" bolts, 3 ½" x ⅛" bolts, 11 ¼" x ⅛" bolts, 8 3/16" flat washers, 8 ⅛" flat washers, 2 ⅛" or 3/16" rubber grommets, 2 ⅜" or ½" rubber grommet., length of 3-core 40/36 rubber-covered cable, 2 25 ampere battery clips, approx. 3½ft 16 SWG enamelled wire, 1 insulated pillar ½" long.

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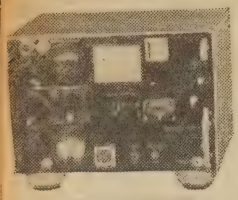
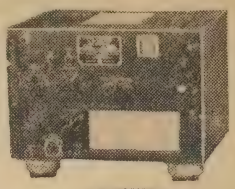


TRANSMITTER



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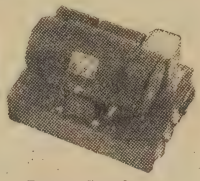

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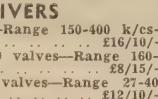

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two wires protrude from one sleeve of spaghetti, twist and solder the ends together when soldering the lead into its place in the circuitry.

It is essential that the leads from the two primary windings be connected into circuit in the correct phase. The color code will show the leads in the correct order as though you were working down from top to bottom in the circuit diagram.

For 6 volt operation, you will see that the "top" lead of the "top" primary winding and the "top" lead of the "bottom" winding connect to the interrupter contacts on one side of the interrupter vibrating reed. The "bottom" ends of both windings should then go to the contacts on the other side of the reed.

For 12 volt operation, the "bottom" of one winding and the "top" of the other are connected to form the centre-tap while the outer leads connect to the contacts on either side of the vibrating reed, each pair of which are connected in parallel. The centre-taps of the individual windings are not used in this case and should be tucked away, making sure that there is no risk of short-circuiting to the metal plate or case.

EARTH POINTS

The main earth point on the internal mounting plate is at the bolt which holds the 7-tap mounting strip. To this point connects pin 6 of the interrupter socket, the electrostatic shield of the transformer, the earth side of the two .1 mfd 600VW capacitors, the lead to the main case and the incoming battery lead marked "chassis." The lead from pin 6 of the socket should be made with heavy flexible lead such as about ¾ inch of the shield braid from shielded hookup wire. The main earth point on the plate is connected to a solder lug mounted under the nut of one of the bolts holding the switch as the connection to the main case. The "earth" pin of the output socket is also connected to this point.

The fuse in the original unit was arranged simply by soldering a scrap of fine wire, about 28 SWG, between two of the lugs on the 7-tag strip.

The RF choke consists of about 23 turns of 16 SWG enamelled wire wound to ¼ inch diameter. While the number of turns is not very critical, it is important that the wire size be adequate to carry the current without heating and causing excessive voltage drop. Keep the leads from the transformer running down that side of the plate away from the RF choke as far as possible.

BATTERY LEADS

For the leads from the battery, use multistrand 3-core rubber-covered cable of the heaviest size you can get. A good choice is 40/36 which has 40 strands of 36 gauge wire in each of the three cores. Twist two of the cores, say the red and black, together at each end and call that the "active" lead. The green core will be the "chassis" lead. Fit the 25 ampere size of battery clips to the free end. Use a short piece of one of the cores for the wiring to the switch.

This cable is clamped to the inside mounting plate at the point of

(Continued on Page 71)

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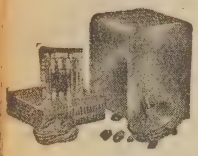

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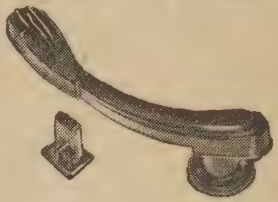

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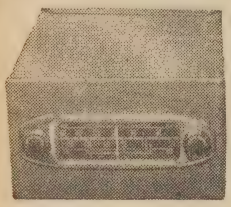

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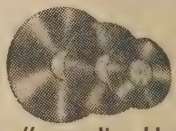

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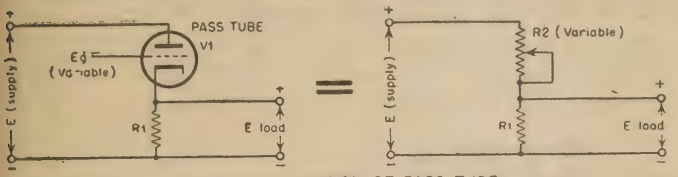
FORTUNATELY, the development of electronically regulated sources has advanced to the state where their design and construction is well within the scope of the average user.

This article outlines the theory, design and construction of a representative supply of this type. With a firm understanding of the design principles to be discussed, the reader should be able to adapt the practical supply presented here to other requirements which might exist.

Modern regulated supplies of the type to be described make available an output voltage which is continuously variable over a considerable range and which will not vary more than a fraction of one per cent between no-load and full-load conditions. Normal line voltage fluctuations also have little effect on output voltage.



ILLUSTRATING ACTION OF PASS TUBE
FIG. 1

In addition, the regulation may be made of such a high order that ripple voltages in the output are almost entirely cancelled, thus eliminating the need for the usual "brute force" filter. This saving in weight and space helps to compensate for the additional complexity of the electronic regulator.

To achieve precise voltage regulation, an electronic voltage control element must be introduced in the conventional supply circuit.

In most regulated supplies, this electronically variable element takes the form of a high current vacuum-tube, usually called the "pass tube" or "regulator tube" in this application. This tube is connected in series with the load resistance across the output of the supply, as in Fig. 1.

Since the resistance of the triode varies as a function of its grid voltage, this combination acts as an electronically-controlled voltage divider. A small change in the regulator tube grid voltage changes the effective ratio of the divider and thus varies the voltage appearing across the output load.

The ability to vary the output voltage of the supply by a minute grid voltage change suggests that automatic voltage regulation could be accomplished by feeding any attempted output voltage fluctuation back to the grid at such a polarity as to oppose that change.

In other words, if the voltage across the load in Fig. 1 attempted to rise, the grid of the pass tube (V1) should be made more negative so that its internal resistance would increase and lower the load voltage. If the load voltage attempted to decrease, the converse action should occur.

This action is achieved by the circuit shown in simplified form in Fig. 2. Auxiliary circuitry consisting of a second vacuum tube, usually called the "control tube," and a constant voltage source such as a battery or "VR" tube is added to the circuit of Fig. 1.

A sample of the output voltage is applied to the grid of the control tube by a tap on the output bleeder, R1. The control tube determines the bias on the regulator tube (V1), since the load resistor (R2) for the control tube is also the bias resistor for the regulator tube.

The control tube, therefore, performs two functions: It amplifies voltage fluctuations impressed upon its grid by the output circuit, and it reverses the phase of those fluctuations so that they may be applied to the grid of the pass tube in the right direction to effect regulation.

The precision of the regulation attained increases with the gain of the control tube, since, with greater gain, a small change in control tube grid voltage will cause a greater control tube current change, and hence a greater change in pass tube bias. Thus, smaller attempted output voltage excursions will be corrected.

REFERENCE VOLTAGE

The battery or VR tube maintains the cathode of the control tube at a constant voltage above ground, and thus provides a standard reference voltage to which voltage fluctuations at the output divider (R1) are compared. The voltage at the grid of the control tube is the difference between the voltage at the output bleeder tap and the reference bias voltage provided by the VR tube.

This difference voltage sets the "target" voltage to which the supply regulates. By changing the output bleeder tap with a potentiometer at R1, the regulated output voltage of the supply may be adjusted within certain limits.

Summarised briefly, the action of the electronic regulator of Fig. 2 is as follows: The position of the bleeder tap on R1 determines the output voltage level to which the supply will regulate.

If the voltage across the bleeder attempts to rise above that level, the bias on the control tube (V2) becomes positive, causing it to draw more current through its load resistor (R2). The increased current through R2 causes the grid of the regulator tube (V1) to be driven more negative, with the result that the resistance of the regulator tube increases sufficiently to prevent the original attempted excursion of output voltage and return it to the regulated level.

If the output voltage attempts to decrease, the sequence of events is exactly opposite. The action is practically instantaneous, so that excursions are corrected while still very small.

TABLE I	
TUBE TYPE	CURRENT (Ma)
6AS7G	250
6A3	75
2A3	75
6B4G	75
6A5G	75
807 *	80
6L6 *	75
6V6 *	45
6F6 *	40
6Y6 *	60

* Screen connected to plate through 500 Ohm, 1 Watt resistor

With a working knowledge of the functions of all component parts, the design of regulated power supply equipment is no more complicated than that of other electronic circuitry usually designed and constructed by the user.

As with any power supply design, the first step is to determine the desired output voltage and current requirements. This permits the selection of the proper power transformer, filter components, and pass tube.

The supply section differs from standard design only in that considerably more voltage than the required output voltage must be provided, since there is an appreciable minimum voltage drop across the regulator tube. Usually the unregulated section of the

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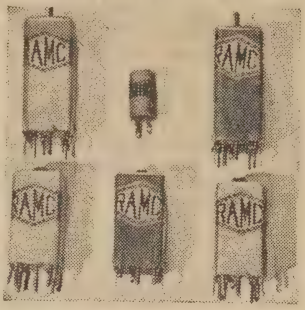

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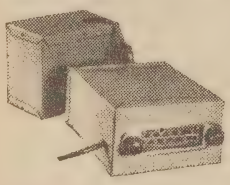

The Radio & Hobbies "Karset" is an efficient 5 valve radio, that can be installed in any car. The receiver incorporates miniature components and valves, housed in a metal case which can be fitted in the glove box, or mounted just under the instrument panel. The power supply is in a separate metal case which allows it to be mounted in any convenient place. The speaker is supplied unmounted, thus allowing flexibility in its placement in the car.

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supply must furnish from 50 to 200 volts more than the desired regulated output.

For a sample design, let us suppose that a regulated output of about 300 volts at 75 milliamperes is required for a general utility supply. The practical circuit for such a supply is shown in Fig. 3.

Knowing the current requirement, a suitable pass tube may be selected from Table 1. Any triode or triode-connected pentode capable of passing the required current at a reasonable voltage drop may be employed.

Tubes may readily be used in parallel where greater current is required or when greater plate dissipation is needed.

The power transformer and filter choke must be conservatively rated for the full load current. Otherwise, the regulation of the supply will be poor.

VOLTAGE RATING

The required voltage rating for the transformer is determined by finding the sum of the voltage drops around the circuit for the condition of maximum output voltage and current. The drop across the pass tube is minimum for maximum output voltage and may be found by referring to the plate characteristic curves for the pass tube being used.

For the 6A3 used in the present design, the minimum tube drop of 140 volts is typical. Thus, the d-c output of the supply section ahead of the regulator must be about 440 volts; 300 volts for the load and 140 minimum drop across the pass tube. Reference to the rectifier tube operating characteristics will indicate the r.m.s. voltage rating of the power transformer required to supply this voltage when a single section choke-input filter is used.

With the 5U4-G employed in the present design, and allowing sufficient margin for voltage drop across the choke, low-line voltage, &c., a transformer delivering 550 volts each side of the centre-tap at 100 ma is indicated. The choke should also be rated at 100 ma.

PLATE DISSIPATION

At this point, having selected the pass tube and determined the characteristics of the unregulated supply section, it is well to examine the pass tube operating conditions to determine if the allowable plate dissipation is being exceeded.

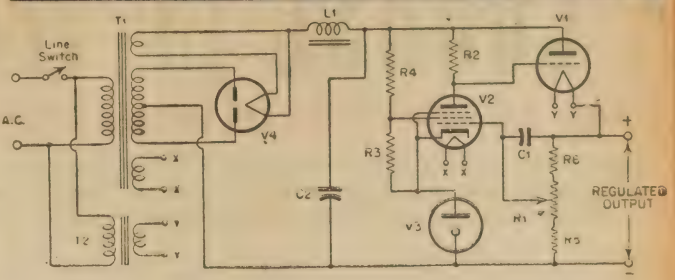
The 6A3 is rated at 15 watts maximum dissipation. At full current and voltage from the supply, the drop across the pass tube estimated above was 140 volts. The plate dissipation under this condition is 140v. times .075 amp. or 10.5 watts.

The low voltage limit to which the supply can safely be adjusted at full current may now be determined, since the voltage drop across the pass tube, and hence its plate dissipation, is maximum at the lowest regulated output voltage. The allowable drop for 15 watts plate dissipation is now calculated as 15 watts, .075 amp. or 200 volts.

With a total unregulated voltage of 440v. available, the minimum regulated output of the supply is thus 240 volts. By using a larger pass tube, or several in parallel, the range of regulated voltage adjustment can be appreciably extended.

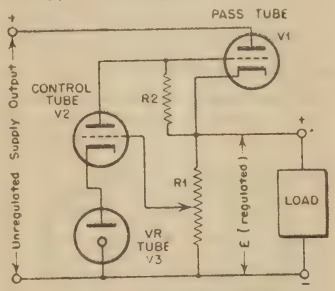
The choice of a control tube is rather arbitrary. Almost any pentode having a sharp cut-off characteristic may be used. The type most frequently employed in electronically-regulated supplies is the 6SJ7, which is chosen for its low cost, ready availability, and high gain.

CIRCUIT OF A TYPICAL SUPPLY



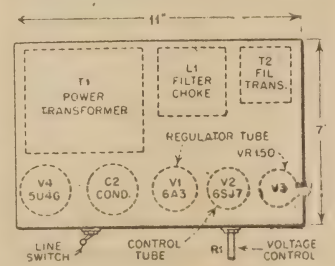
R1, R5, R6 – See text
R2 – .47 Megohm, 1 Watt
R3 – 12,000 Ohms, 5 Watt
R4 – 18,000 " " "
L1 – Filter choke, 8 Hy., 100 Ma
C1 – .25 µfd.,
C2 – 8 µfd., Electrolytic,
T1 – Power Transf., 550-0-550 V @ 100 Ma 5V.@ 3A. and 6.3 V @ 1A.
T2 – Filament Transf., 6.3 V @ 1A.
V1 – 6A3
V2 – 6SJ7
V3 – VR150
V4 – 5U4G

PRACTICAL REGULATED SUPPLY
FIG. 3



SIMPLIFIED
ELECTRONIC REGULATOR
FIG. 2

Although batteries may be used for the source of control tube reference bias voltage, the gaseous voltage regulator tube is usually preferred. Tubes of the "VR" series



SUGGESTED PARTS LAYOUT
FOR REGULATED SUPPLY
FIG. 4

give excellent life and stabilisation in this application.

The choice of VR type, VR75, 90, 105 or 150 depends on the unregulated voltage available and the portion of this which must be reserved for drop across the load-bias resistor (R2) and the control tube. It is desirable to utilise the highest voltage VR tube possible under these conditions, since this subjects the grid of the control tube to a larger portion of output voltage fluctuations.

A VR150 is sufficient for the design being discussed, since the bias developed across R2 to reduce the output voltage to minimum is only about -30 volts, as indicated by the plate curves for the 6A3.

The plate load resistor (R2) is chosen to be about equal to the plate resistance of the control tube. Values between .47 and .68 megohm are typical for the 6SJ7.

BYPASS CONDENSER

The by-pass capacitor, C1, is usually about .25 microfarads. It provides a path for 120 cycle ripple voltages and other high frequency fluctuations between the regulated output and the grid of the control tube.

The dropping resistors R3 and R4 are designed to provide 150 volts across the VR tube at the 8 mA minimum current required for regulation and to provide a tap for control tube screen voltage. In computing the values of these resistors, the minimum unregulated supply output voltage must be used.

Allowing for 10 per cent drop in line voltage, this would be 396 volts. At .008 ampere drain, the total resistance required (R3 and R4) is 246/.008 or 30,750 ohms.

The portion of this resistance between the cathode and screen voltage of 100 volts should be 100/.008 or 12,500 ohms. Thus the nearest standard values of 12,000 and 18,000 ohms will suffice for R3 and R4 respectively.

The total resistance value for the output bleeder is usually about .25 megohm, made up of a 50,000 wire-

(Continued on Page 59)

A COURSE IN TELEVISION

PART 23 — SAWTOOTH GENERATORS (CONTINUED)

There is yet another form of oscillator which is frequently used to discharge the R/C circuit in a television time base and this is known as "multivibrator." It employs essentially the same circuit as in the well known item of test gear which goes by the same name.

FIGURE 1 gives the essential details of a typical multivibrator circuit using a pair of triodes, or a twin triode.

Essentially, each unit is wired as a resistance-coupled amplifier, but the plate of each is coupled to the grid of its opposite number, so that a form of feedback takes place. To clarify explanation, the various components have been branded with the numerals 1 and 2, referring to the respective amplifier sections.

In tracing the operation of an oscillatory circuit, it is always necessary to assume some movement of the current or voltage in the circuit to provide a starting point. In practice there is never any lack of such initial impulse.

Let us assume then, that there is a slight initial positive impulse on the grid of V1. This causes an increase in the plate current of V1 and, by reason of the added voltage drop across Rp1, it brings about a slight reduction in the plate potential.

This negative-going impulse at the plate of V1 is communicated in turn to the grid of V2, causing a reduction in the plate current of V2 and a consequent rise in plate voltage.

FEEDBACK EFFECT

This rise in plate voltage is communicated back to the grid of V1 as an amplified positive impulse, adding to the impulse which originated the action. The effect is therefore cumulative, building up a positive signal in the grid of V1 and a large negative signal on the grid of V2. The action must obviously cease when the plate current of V1 reaches saturation and/or the plate current of V2 is cut off.

However, the circuit cannot remain in this condition because, immediately the action ceases, the signal voltage applied to each grid by its coupling condenser tends to leak away via the grid resistors. Hence the grid of V1 begins to lose its positive potential while the grid of V2 conversely becomes less negative.

When the grid of V2 rises above cut-off, V2 begins to conduct and accelerates the changing conditions, so that its own grid is driven highly positive while that of V2 goes highly negative.

The process simply repeats itself indefinitely, the oscillation normally being of such a character that the respective grids are driven a long way beyond cut-off on each half-cycle. A relatively long period may therefore elapse while the coupling condensers are charging (or discharging), during which time one or other of the triodes is cut off.

Thus, the operation of the circuit may be summed up by saying that one valve is conducting while the other is cut off, the position being periodically and abruptly reversed. The exact frequency of this reversal process and the steepness of the wavefront is governed by the circuit constants, the operating voltages and so on, which we have no need to examine here in any greater detail.

However, the potential at each plate varies abruptly from the H.T. supply figure, when the plate current is cut off, to some lesser value when the valve is conducting. This is illustrated in figure 1b.

If the circuit is symmetrical, the same deviation will be present at both plates, the output waveform beng approximately rectangular. By deliberately unbalancing the circuit so that V1 and V2 have different operating conditions, a variety of angular waveforms can be achieved.

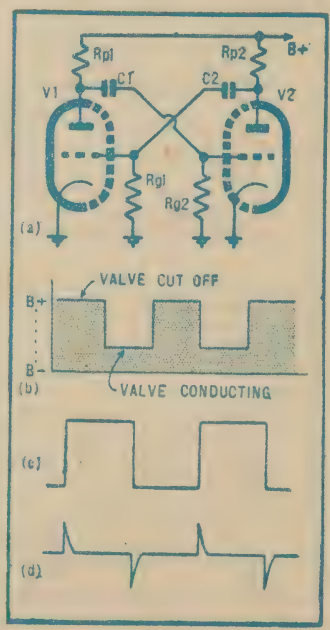


Figure 1: A basic multi-vibrator circuit (a) with plate voltage variation (b), output waveform (c) and output after differentiation (d).

A multivibrator can readily be synchronised with an external signal having a slightly higher repetition frequency than that to which the multivibrator is adjusted. The external synchronising voltage, which should be positive-going in character, can be applied to either grid or plate circuit.

After a few cycles of operation, the positive-going synch. pulse will inevitably arrive at one grid just as it is drifting from cut-off into the conducting region. At this point the positive pulse triggers off the action just slightly before it would normally take place and, thereafter, the multivibrator will remain in step with the synchronising pulses.

OUTPUT WAVEFORM

As illustrated in figure 1b, the output from either plate of a multivibrator tends toward a rectangular waveform which is not directly suitable for controlling an R/C timing circuit.

The normal procedure, therefore, is to take the output from one plate through a resistance-capacitance coupling circuit having a deliberately short time constant—in other words, the now familiar "differentiating" circuit. As a result, the square wave of figure 1c is resolved into a series of spikes as in 1d, the positive going spikes being the ones normally required.

These can be applied in turn to the grid of a valve connected across the timing condenser, the positive pulses causing the discharge valve to draw plate current and thereby discharge the associated condenser. This system would thus call for at least three triodes, of which two could obviously be part of a twin valve.

LINEARITY PROBLEMS

So much then for the multivibrator. Like the squegging oscillator and other possible forms of hard valve time base, it serves ultimately to discharge the condenser in an R/C circuit at regular and synchronised intervals. The slower charging cycle provides the forward trace, which moves the spot from left to right or from top to bottom to build up the complete picture.

The problem remains, however, of obtaining a substantial peak signal voltage from the charging circuit consistent with good linearity. As mentioned earlier, a high peak

output can be obtained by allowing the charging cycle to run its course but the linearity then becomes very bad and completely hopeless for television purposes.

The linearising pentode idea, as employed with gaseous valves — or thyratrons—can improve matters considerably, particularly when their action is reinforced by the application of current feedback. The obvious objection to this scheme is the need for yet another valve and a good deal of associated circuitry.

COMPENSATION METHODS

It is uneconomical simply to limit the charging cycle for the sake of linearity, because the reduction in output voltage may make another sweep amplifier stage necessary, so that little is gained in the long run. What is required, therefore, is some method of linearising the trace without sacrificing too much output and which does not require additional valves.

One scheme, which has been used, involves placing partially saturated chokes in the timing or amplifier circuit, which change their inductance with the amount of current passing through them. By very careful control of circuit values, the chokes can be given a characteristic such that it opposes the non-linearity of the sweep waveform and gives an acceptable result.

The need for critical control and adjustment during manufacture limits the appeal of the system.

A more practical arrangement involves replacing the single timing condenser with a subsidiary network which has a time constant different from the timing network as a whole. A typical circuit is shown in figure 2.

Here the normal timing condenser C has been replaced by two condensers in series, namely C1 and C2. A subsidiary circuit comprising R2 and C3 are connected across C1, while R1 provides the major resistive component.

HOW IT OPERATES

Assume for a start that C1 and C2 have just reached the condition of maximum charge, an instant before the discharged circuit is due to operate. Obviously, C3 will not be fully charged since it is charged from C1, but the process is delayed by the presence of R2.

Provided that the circuit constants are properly chosen, C1 will never remain in a state of steady charge so that the potential across C3 will never peak to the same value as that across C1.

When the discharge device operates, both C1 and C2 are discharged almost immediately, but C3 is not abruptly discharged because of R2.

The sawtooth output circuit includes C3, so that operation of the discharge device does not reduce the instantaneous sawtooth output to zero, but to a voltage closely approximating the charge across C3.

However, the charge across C3 immediately begins to drain into C1, which, by this time is also charging

MODIFIED CIRCUIT

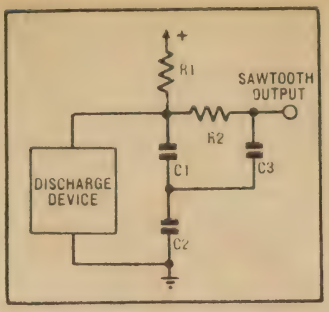


Figure 2. The circuit of self-compensated R/C discharge circuit, as commonly used in TV receivers.

slowly from the external circuit. Thus, at the beginning of the cycle, the sawtooth output voltage is the arithmetical mean between the falling charge across C3 and the rising charge across C2.

Ultimately the charge across C3 will equal and then fall below that across C1, ready for the next cycle of events.

It is apparent, however, that the resultant of the two effects is a more nearly linear output voltage, the exact shape of the curve being subject to easy adjustment and control.

AMPLIFICATION

But even allowing for such compensation, it is usually necessary to provide some amplification of the sweep voltages, either to obtain sufficient peak voltage swing for electrostatic deflection or sufficient current change for electromagnetic deflection.

Without going into great detail at this stage, the design technique surrounding sweep amplifier circuits is somewhat similar to that required for video amplifiers.

The frame oscillator and sweep present no great difficulty, because the repetition rate is quite low—a matter of 50 cps. Actually, the amplifier needs to handle much higher

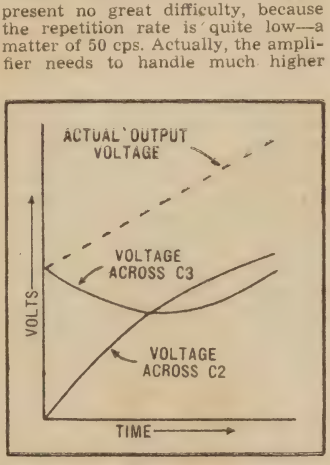


Figure 3. Illustrating the voltage across C2 and C3, with the resultant output, which is much more nearly linear than it would otherwise be.

frequency components than this, due to the angular nature of the wave.

To transmit a perfect triangular wave would actually require frequency components extending to infinity, but, in practice, it is usually sufficient to ensure that the amplifier will handle faithfully a range extending to some 15 or 20 times the repetition rate. With a frame frequency of 50, this only extends the necessary range to 2000 odd cps.

In the case of the line circuits, which have a repetition rate of about 15 Kc, the amplifier and deflection circuits must handle components to between 225 and 300 Kc.

Having surveyed some typical time base circuits, it is now appropriate to examine the voltages required to deflect the beam of typical cathode ray tubes.

The largest tubes with which readers are likely to be familiar are the 5-inch variety, employing electrostatic focus and deflection.

SENSITIVITY

The deflection sensitivity of such tubes varies with the operating potential, the sensitivity decreasing as the accelerating voltages are raised. The reason for this is simply that a high velocity electron beam is less readily influenced by external fields than one having a lower velocity.

For television service, cathode ray tubes must be operated at higher potentials than necessary for instrument work, both in the interests of accurate focus and also to produce sufficient light over the total screen area.

The familiar 5BP1 requires about 76 volts to deflect the beam by one inch, assuming the use of the most sensitive plates and a high operating potential.

To make full use of the screen, it may be necessary to deflect the beam for the horizontal scan by about four inches, so that the peak-to-peak value of the deflection voltage required would be 4 x 76, or 304 volts.

If the deflector plates are operated in push-pull, this means an approximate 150 volt peak-to-peak swing on each and the resistance coupled driving stage would need to be operated from an effective H.T. supply of nearly double this value —something approaching 300 volts.

COMMON PRACTICE

All this can be arranged conveniently and is common practice in laboratory oscilloscopes.

However, as the size of the cathode ray tube is increased, it is necessary to operate at higher "gun" voltages and, of course, to provide for greater deflection. Thus, a typical 7in American picture tube, employing electrostatic deflection, is quoted as requiring between 150 and 250 volts per inch of deflection for a picture width of 5½ inches.

Taking an in-between figure, it is obvious that a peak-to-peak swing of 1000 volts must be established between the deflector plates, or a peak-to-peak figure of 500 volts on each

(Continued on Page 79)

their tones to suit the music, it's not fixed like an audio oscillator.

"A violinist playing music of a brilliant nature will often pitch his instrument slightly sharp to achieve that brilliance.

"W.N. may have been in a bad position, even though he picked it so carefully . . . The ABC engineers in their wisdom placed the microphone where the ratio of direct sound to reflected sound would be as large as possible . . ."

Another reader (H.R., of Roseville, NSW) comments in similar strain:—

". . . I wonder what the verdict would have been if W.N. had genuinely tried a number of seats all over the hall to find the best and not just taken a guess dependent on his preconceived ideas or, like many of us, on his pocket.

BEST SEAT?

"From experience in the Sydney Town Hall, I find the best seats for hearing the orchestra to be those in the galleries nearest the ABC microphones. Conversely, on odd occasions, when I was seated far down the hall, the sound was so woolly that I wondered vaguely, like W.N., whether my amplifier had deceived my ears.

"W.N. says that no one in his senses wishes to hear directly an orchestra or a brass band from the microphone position. It follows then that most conductors are out of their minds."

Let's Buy An Argument

Looking back over the mail for the last couple of months, I realise that there are several loose ends to be gathered up. Unless I do this, I shall find myself accussed either of ignoring letters or on the other hand, of side-stepping problems which seem too hard.

by W. N. Williams

ONE matter concerns the letter which was published in the February issue over the initials "W.N. (Wayville)." You will remember that this correspondent made some provocative statements about "violin tone," high note harshness from orchestral instruments and about microphone placement. His further mention of "the most desired seat" in the hall brought forth quite a bit of comment.

It even started something in our own office when the Editor got into verbal holts with another member of our staff who happened to hold differing views. Apparently this "other member" is as keen on sound as he is on photography. Enough said.

Had it been possible to transcribe all the statements, I would not have had to worry about these columns for several issues to come.

Most potent comment from outside the sanctum comes from Mr. Reeves, of Roseville, NSW, who felt prompted "to stir up the embers in this untouched part of the fire."

Says Mr. Reeves, *". . . W.N. talks of no highs and then of harsh screeching overtones which the players tried desperately to eliminate. Dear me! What does he mean?*

"Apart from the apparent contradiction, how does he know that the musicians tried desperately to eliminate these overtones? Violinists alter

May I continue on from there and suggest that there is far too much glib talk about a performance sounding "just like it would in the hall." The point is—How does it sound in the hall? In which hall?

There is no such thing as a "standard" auditorium. Some are large, some are small. Some are heavily damped, others are full of violent echoes.

The energy distribution of the sound varies widely with position. Some would never think of sitting anywhere else in the Sydney Town Hall but in the forward stalls. Others pick a position in the side galleries, while others deliberately go for the little gallery right at the back.

But even supposing it were possible to select an "optimum" seat in a "standard" hall, it would not be satisfactory to perch the microphone on the cushion and forget it. The

reason — the microphone would "hear" things differently from a listener on the same spot.

Before you condemn this statement as obviously silly, make a simple test next time you find yourself in a concert hall. More simply a conversation in a restaurant will do by way of illustration.

In the normal way you can converse with your friend without difficulty, even above the hum of other conversation, the banging of dishes and the whistling of soup. Why? Because you have two ears!

The very sense which allows you to determine the direction from which a sound comes, also allows you to select the direction from which you want to hear. You unconsciously reject the noise and "focus" your hearing across the table.

BACKGROUND NOISE

But block one ear and the noise level immediately appears to rise. The conversation is submerged in a background you had scarcely noticed before.

The listener in a concert hall uses the same process quite unconsciously to reject echoes and the audience noise round about and to listen primarily to the orchestra. What's more, depending on position and faculties, he can often choose to listen to the orchestra as a whole or to concentrate on a particular section of it.

The microphone, being a single ear, simply cannot exercise this process of selection and, before you could so kindly select a site on its behalf, you would have to thread your way through the audience with one ear stuffed tight with cotton-wool or chewing-gum.

I strongly suspect that you would finish up leaving the microphone where it was—suspended in free space above and in front of the orchestra.

Don't make the mistake either, of thinking you can capture the same selective or spacial effect by using a number of separate microphones feeding into a common channel. I have serious reservations about the multiple microphone idea, even though it is sometimes used.

In some cases, I can well imagine that it would lend an acceptable broadening or a reverberative effect, but what confusion there must be on staccato sounds when sharp wavefronts arrive at the individual diaphragms at slightly different time intervals! This in addition to the deteriorating effect of normal room echoes.

SQUARE WAVES

So much for that subject.

Readers are still puzzling about the likely behavior of magnetic cutters with square wave input. The ideas about differentiation and integration, as expressed in past issues, have certainly not found universal acceptance, at least not in detail. From Brisbane, B.M.B. writes:

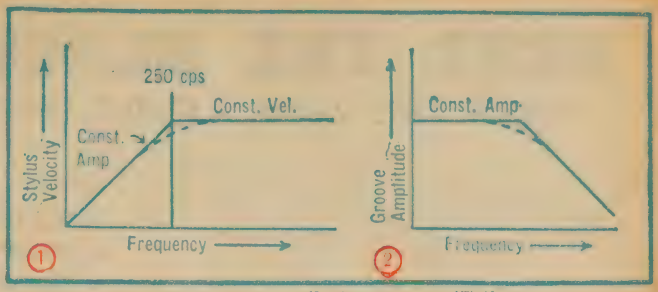


Figure 1 shows the standard EMI recording characteristic while figure 2 shows the same information in a different form.

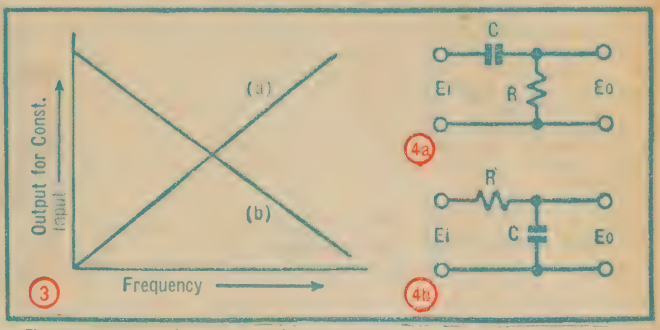


Figure 3 suggests the response characteristics which could be expected from the two simple networks which appear as 4a and 4b.

"Finally a few gurgles of astonishment at a reader's diatribe on integration and differentiation in the December issue. While the suggestions would not exactly make Maclaurin or Taylor turn in the grave, the assumption that a speaker is a mechanical integrating device (I think it was) is to say the least phenomenal.

"As for integration smoothing out curves, e.g., on records, this is in general quite so, but would be of no use at all in the relatively sharp discontinuities present in VF recordings. Also much intelligence would be lost in the varying attenuation with frequency of differentiating and integrating devices."

WHO DOES KNOW?

All this, of course, could lead to a prolonged mathematical argument which would (1) drive our linotype operators mad trying to set the stuff and (2) discourage 99 pc of readers from trying to follow the argument, anyway.

However, I must give due attention to a letter from A.N.T., of Randwick, NSW.

In a rather lengthy discourse, he raises several points to which we can refer later. However, on the subject of recorded waveshape, he confesses to the "dreadful suspicion" that I—and presumably others—don't really know what happens when an attempt is made to record a square wave.

I must confess to a certain amount of "foxing," in the interests of the argument, but the suspicion has some foundation in fact. I had never had occasion to think about it in great detail before and lacked the usual stock of ready-made answers. However, in all the weeks that the subject has been under discussion, I have not met a single person who has been able to say, with due flourish and assurance, "this is precisely what happens . . ."

Apart from a good deal of what our correspondent refers to as "woolly thinking," there is a real lack of knowledge about the mechanical limitations which must be brought into the picture alongside purely electrical laws. Until these mechanical quantities are resolved, there will remain a good deal of room for conjecture.

However, to summarise the relevant portion of the letter from A.N.T., he emphasises first of all that the standard EMI recording characteristic is as shown in figure 1. Here we quote:

APPLYING CURVES

"If we redraw this curve as in figure 2, which shows groove amplitude, we incidentally have the response obtained from an ideal crystal pickup off a test record.

"Now consider the curves of figure 3 which refer to the filters shown in figure 4. These are ideal curves. Figure 4a has a very short time constant, approaching zero, while 4b has a very long time constant approaching infinity.

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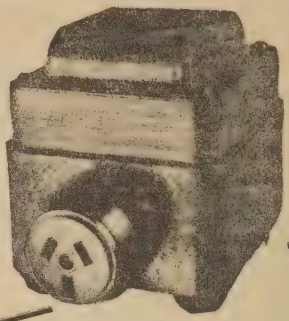
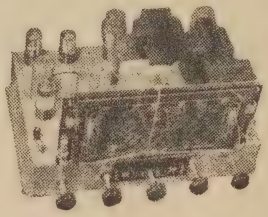


E.P. KITSETS



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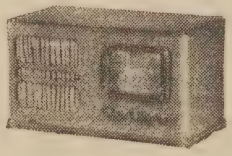

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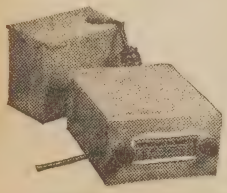

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"Now if we integrate the output of a magnetic pickup (i.e., use an integrating type of equaliser circuit), the resultant output can be found by applying curve 3b to curve 1. The result will be figure 2 (which is the same as for a crystal pickup).

"Again, if the output of a crystal pickup is differentiated, we can apply figure 3a to figure 2 which results in figure 1.

"Thus by using simple R/C networks, we can make both types of pickup identical in frequency response and it can easily be shown that phase rotation is also identical.

"In practice, we wish to obtain a characteristic which is flat over the whole range, so we only equalise each type over the relevant portion of the range.

"Thus, with an ideal crystal pickup, we only differentiate the output above the cross-over frequency, using a network of the type 5a. Conversely for magnetic pickups, we use 5b."

Our correspondent then points out that, in poorly designed pickups, the presence of arm or needle resonance effects may make it necessary to modify these basic equalising networks or to omit them in favor of simple resistive "loading." The net result will then be a peaky response curve, which is far removed from the ideal.

IMPORTANT POINT

So far so good. It is interesting to note that A.N.T. derives the same conclusion as I did in an early article in this series—namely, that the application of proper measures to correct frequency response can be expected also to correct phase relationships.

I took it in a wider sense, however, to cover the whole input system, if need be. The point which emerges is that you get precisely the same output from a given groove shape with either an ideal crystal or an ideal magnetic pickup, provided each one is correctly compensated in terms of frequency response. And I would suggest that it is immaterial whether the correction is applied directly at the pickup terminals or in a subsequent equalising stage.

Right then! If you will accept this premise in relation to pickups, then it must logically apply also to recording heads. If, by devious means, you force all cutters to follow a standardised velocity or amplitude law, then they will also conform to a standardised pattern or phase rotation and groove shape, irrespective of type.

DRIVING VOLTAGE

Previous correspondents have contended that, for the same driving voltage, a magnetic cutter will produce a fundamentally different groove from a crystal cutter.

Taken on its face value, the contention may be quite correct. For the same reason, it can be claimed, with

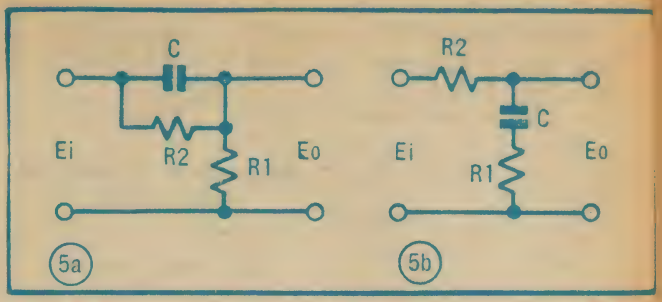
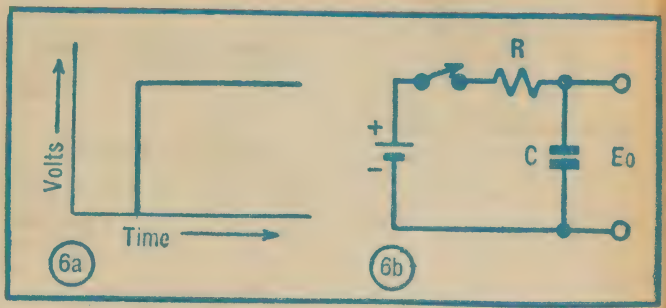


Figure 5a shows the bias filter required for an ideal crystal pickup, while 5b shows equivalent filter for an ideal magnetic.



Illustrating in 6a a basic transient rather than a complete square wave. B shows the corresponding electrical circuit which is used as a basis of calculation.

justification, that a track made by a crystal cutter must be played back with a crystal pickup and similarly for the magnetic case. The source and "load" impedance for each should ideally be defined but we can afford to ignore this extra complication.

What the above statement does assume is that the cutter in each case is allowed to follow its own natural frequency amplitude law, and likewise the pickup. In the practical case this is not so. For reasons which are well known, EVERY record is cut

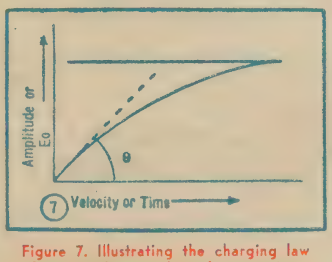


Figure 7. Illustrating the charging law of a condenser through a resistor. Our correspondent applies this same law to a cutter recording a vertical transient and works out a value for angle theta.

to some standardised and predetermined frequency/amplitude law, irrespective of the cutter used for the job. The circuitry which is necessary to ensure that each cutter does the right thing is a sure guarantee that the actual driving voltage for

crystal and magnetic cutters DIFFERENT not identical.

The Editor and I have bee close to this problen in recent week as will be evident from an artic elsewhere in the issue. In orde to make a magnetic cutter confor to the accepted recording charac teristic, it has been necessary t make a careful study of its mechani cal attributes, its impedance v. fre quency characteristic, the couplin network and the source impedanc from which it is fed.

This process of electrical an mechanical compensation is fre quently carried to surprising length to get just the right amplitude/fre quency law in the finished groov

With a crystal cutter, the method of coupling and equalising must b quite different if it is to follow th same ideal amplitude/frequency law

By the time a given input signa traverses the individual networks the voltage across the actual termi nals of the magnetic cutter would b different from that across the actua terminals of the crystal cutter.

Most of the arguments, to date about complex waveforms mus therefore be scrubbed because they have missed this vital point.

It becomes necessary to think o a cutter, not as an individual iten but in association with its comple mentary equalising network, which may reach deep into the entrails o the recording amplifier.

In fact the whole recording system must be regarded as a unit which receives a nominally level input

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signal and proceeds to cut a groove conforming to a pre-determined amplitude-frequency law.

Precisely the same is true in reverse of the pickup and its associated equalising circuits. They are stimulated by the said amplitude/frequency-conscious groove and produce what should be a level output.

Taking the ideal case, you have merely passed the signal through a highly complex electro-mechanical network from which all the reactive components cancel out to produce an input v. output curve which is not frequency-conscious and which shows zero phase shift.

How close you come to this ideal in practice would be a measure of the design merit.

It matters little whether you use a magnetic, a crystal or any other conceivable type of cutter. With due and necessary equalisation, each will cut the same groove. And you can play the said groove with any pickup you like. After equalisation, the output signal will be the same.

Sounds reasonable, doesn't it?

PHASE ROTATION

What I had to say last month about the audible effects of phase rotation —or the lack of them—still holds good, except that it doesn't have to be brought into the firing line.

Now for the business of square wave recording. Maybe we can sort that out, too.

A lot of time has been spent discussing whether or not a cutting stylus could be made to describe a substantially flip-flop motion which would be the pre-requisite of a square-looking wave.

There is no doubt that a cutter can be made to do just that but the consensus of opinion is that any combination of frequency and amplitude which would cause the cutter to behave in that fashion would represent an overload condition.

Presumably, the imposition of the accepted amplitude/velocity characteristic, together with accepted recordings levels, would keep the stylus within the range of movement where the constant/velocity characteristic would be preserved.

Taking this latter point as read, it would mean that the original square-wave impulse would indeed produce a triangular-shaped track.

The leading edge of the square wave would be the signal for the stylus to reverse its direction. Thereafter, with a constant voltage temporarily across its terminals, the stylus would accelerate toward the opposite pole. It would continue to do so until the next vertical stroke on the square wave caused it to reverse direction again and so on, ad lib.

AMERICAN PRACTICE

On this basis it is possible now to introduce the lineal groove speed and to calculate the angle of slope. Our friend A.N.T. does it very nicely. He points out initially, that a cutter is made to follow the law indicated by figure 2. This plot of amplitude against frequency is exactly the same as a plot of voltage against frequency for the differentiating circuit of figure 4b. In other words, an analysis of figure 4b in terms of voltage will also hold for cutter response in terms of amplitude.

Further to simplify matters, he proceeds to substitute a simple square-fronted transient for the complete train of square waves. The problem now is to analyse the behavior of figure 6b with an input as in 6a. We quote:—

"Now the response of this circuit to a square-fronted transient is well known. It is the case of a condenser charging up through a resistor when DC is applied."

Our correspondent then goes on to analyse figure 7 and, at short notice, it would involve major type-setting difficulties to reproduce his figures. However, taking the EMI crossover frequency and maximum recording amplitude near the centre of a 78 rpm disc, angle theta is shown to be 30 degrees. At the outside of the same disc it would be a mere 10 degrees.

For American practice it would approach a maximum of 45 degrees. For microgroove recording figures of the same order could be expected, since the rotational speed and t maximum amplitude are scaled do in about the same degree.

Our correspondent concludes:

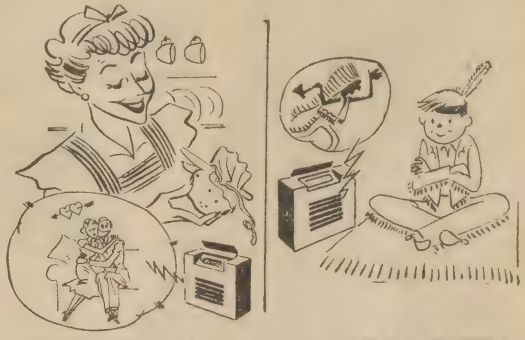
"Where this does break down the case of discs with high freque pre-emphasis."

Need I say any more? I rath think that the foregoing is sufficie for any one month.

Only one thing has me worri As the discussion on this and oth subjects progresses, readers c change their ideas when necessa nod wisely and merely say, Yes, y of course!

But not me! I find that I'm leavi behind a long trail of printed wor which, like the chickens, may o day come fluttering home to roo Sooner or later an irate reader going to write in and say . . . "Y but in the blank issue you sa such and such . . . "

When that happens I may sham facedly admit that my early judg ment could possibly have been error. Either that, or I will go o to a secluded glade and, in the lea obtrusive fashion, put an end to m miserable existence.



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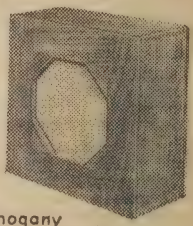

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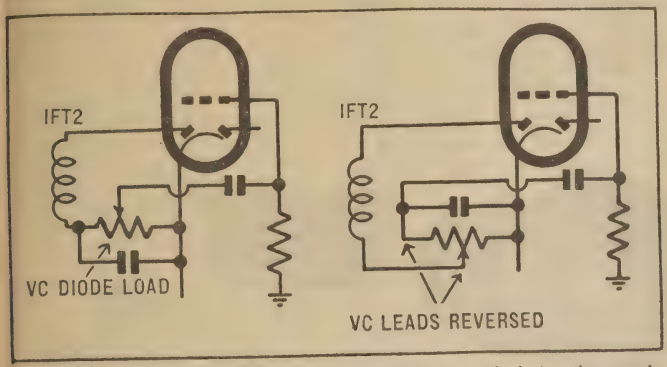
FROM THE SERVICEMAN WHO TELLS

It is frequently and wisely said that "a little knowledge is a dangerous thing." It certainly is when an enthusiastic but not very knowledgeable experimenter sets out to improve on a factory-made set. But, forgive me, I am getting ahead of myself.

THE story had its beginning when a client bought a set "with all faults" at a local junk sale. He knew a little about radio from the old days, and reasoned that he would get his value in parts, even if it could not be repaired economically. However, his initial outlay was so small that he was prepared to spend a reasonable sum on repairs if he could expect a good set out of the transaction.



Distortion on strong signals and abrupt volume control acton resulted when the correct wiring, as on the left, was inadvertently altered to the arrangement on the right.

Thus it was that I was given more or less a free hand to do with the set as I thought fit, a not very common experience, I might add!

The set was a five-valve dual-wave mantel model, and, as I received it, was working on the shortwave band only. Other points I noticed were that the dial glass was broken and that the lugs of the IF transformers were screwed well in.

CASE HISTORY

As far as the new owner could ascertain, the set had been "doctored" by an aspiring "ham," with the idea of improving its shortwave performance. To this end the standard 6J8G converter had been replaced with a type X61M, and the position of the shortwave coils had been changed. Other modifications had also been made, but I was not to discover these until later.

As it was, the vestige of performance which remained was so bad that the set had apparently been abandoned or traded in, ultimately finding its way into the aforementioned junk sale.

On switching it on for the first time, I was able to receive some shortwave signals, but these were badly distorted. Even allowing that shortwave reception is not always perfect, I felt that most of the trouble was in the set. Even the local S/W transmitter was affected, and this can usually be relied upon to supply a good signal.

Nevertheless, I decided to repair the broadcast section before tackling the distortion, since it is easier to work with a signal about which there is no doubt.

The fact that the set was inoperative only on the broadcast band made it almost certain that the trouble was in the broadcast oscillator coil of the wave-change switch. The multimeter confirmed that there was no voltage on the oscillator plate, but that all was well on the other side of the coil winding. This meant that the coil itself was at fault.

I was hoping that the break might be at one end, where it could be repaired, but such was not the case and a new coil had to be fitted.

When this was done and broadcast stations were tuned in, it was at once obvious that the distortion was still present. In fact, it seemed worse, if anything. I checked the HT voltage, the grid bias on both audio tubes, and paid particular attention to the screen of the 6B8G, an open screen resistor being a frequent source of trouble in this position. However, all seemed to be in order, and a further check of resistors with the ohmmeter revealed nothing unexpected.

AUDIO CHECK

I decided to feed a 400-cycle note through the audio stages, and try to track down the offending section with the oscilloscope. Accordingly, I connected it across the output transformer, and was surprised to see the time bias line spread out into a solid rectangle, even though there was no signal audible from the speaker. So this was the explanation of the distortion —supersonic oscillation of the output stage!

But why? This fault is usually the result of poor circuit design or layout or stray capacitance between the plate and the audio input leads. Valves like the 6L6 and the 807 are very prone to this trouble, and the fitting of grid "stopper" resistors is regarded as a standard precaution.

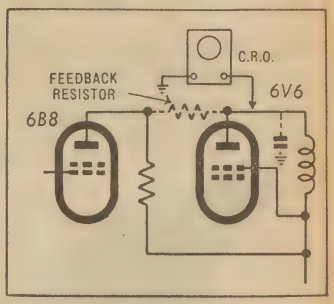
The 6V6, as fitted to this set, does not usually require such elaborate precautions.

It did not seem likely that the set had passed through all the usual factory checks with such a fault unnoticed. In fact, it hardly seemed likely that such a fault would develop in a set designed for large-scale production, since troubles of this nature are usually ironed out in the laboratory before production commences.

ALTERATIONS?

However, I suddenly had a hunch. The fellow who had "doctored" this set had been out after every ounce of gain he could get. It would be quite likely that he had altered a few things in the audio end, and perhaps removed the feedback. I delved into the rather compact wiring, remembering that this set should have a 1 megohm resistor from the plate of the 6V6 to the plate of the 6B8. My hunch was right; it was gone. So, also, apparently, was the usual plate bypass condenser.

New components were fitted and the set switched on again. The oscilloscope showed that the supersonics had vanished, but my ego was sadly deflated when the set started to play. Certainly the distortion was less, but it was still not perfect.



Removing the feedback resistor and the plate bypass, shown dotted, gave more gain and treble response but caused the set to be unstable.

I was about to call the oscilloscope into service again, when my attention was drawn to the volume control. It was obviously a replacement, for the shaft was much longer than the other controls and, in addition, it only needed a bare minimum of rotation from the "off" position to produce full room volume. The volume control itself was of the correct value, so I started on the wiring.

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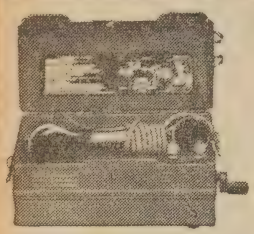

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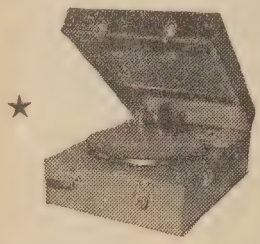

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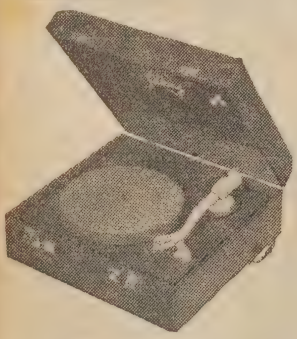

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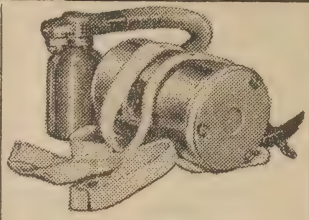

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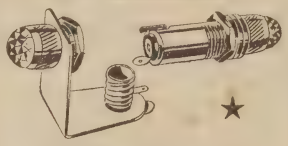

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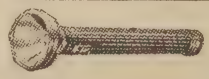

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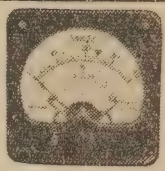

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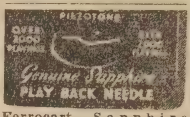

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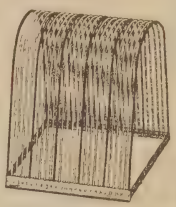

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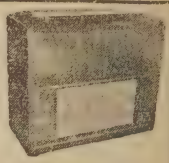

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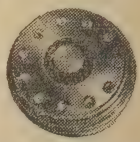
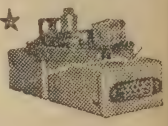
Brand new genuine Iron Cored 455KC I.F. Transformers. As illustrated, cut to only 8/11.



5BP1 Cathode Ray Tube Sockets. Moulded 11-pin sockets with silver plated contacts. As illustrated, 9/6.



"KAR' SET

"Radio and Hobbies" Car Radio Kit as described in May, 1949, issue of "Radio and Hobbies." Homecrafts offer this kit complete to the last nut and bolt. Price as illustrated, 22 **Gns.**, including Sales Tax.

290 LONSDALE ST., MELBOURNE—CENT. 4311

he manufacturer had run all the eads to the pot through a length of netal tubing — and they were all the ame color The ohmmeter soon re- ealed the cause of the trouble. The ead which should have connected to he moving arm of the pot had been vired to the "hot" end, and vice- ersa.

The effect was to control the vol- me not by tapping off an appropriate oltage for the grid of the audio valve ut by varying the value of the diode oad resistor, which was the pot itself n this case. Since the audio section vas wide open all the time, normal oom volume occurred when the diode oad was only a few hundred ohms.

This also explained why the strong ocal stations were more distorted han some of the weaker shortwave tations. In the latter case, the weak ignals allowed the diode load to pproach a more normal value before he output became excessive.

POT. SHAFT

Reversing the leads eliminated the listortion and restored the volume ontrol action to normal. Before fin- lising the wiring, I removed the pot nd cut the shaft to match the other ontrols. This may not sound very mportant, but I have seen it over- ooked on more than one occasion, and he effect on the customer is not a avorable one.

As I mentioned earlier, the short- wave coils had been moved, appar- ently with the intention of shortening he leads. This had certainly been chieved, but, whereas in their orig- nal position they had been rigidly mounted on the chassis, they were ow supported only by their own eads and it had been impossible to educe these much below an inch and a half, anyway.

Whatever academic improvement had resulted from this change had been more than offset by the very real ack of frequency stability caused by the non-rigid coil mounting. I duly remounted the coils in their original position and tidied up the wiring generally.

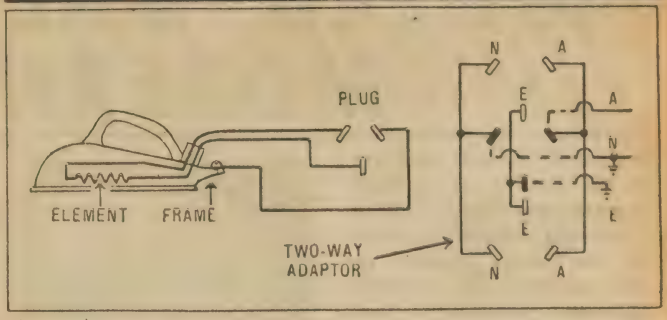
ALIGNMENT

The set was now beginning to look and sound more like the real thing, but the sensitivity was rather on the low side. From the beginning I had been suspicious of the IF transformer adjustments, being, as they were, screwed further in than appeared usual. I suspected that our would-be amateur had attempted to align the set, probably by ear, and fallen into the common trap of setting the slugs on the second peak.

This second peak sometimes occurs when the adjusting slugs are screwed further in than the normal peak posi- tion. In some cases, the second peak is, in fact, a true peak and is simply due to the slug being withdrawn from the opposite side of the winding.

In other cases, considerable coup- ling takes place between the slugs before the windings can be adjusted to resonance and the apparent peak is due more to this coupling than to a true resonance adjustment. When this happens, it produces a false peak, giv- ing poor sensitivity and a broad selec- tivity curve which is also inclined to be lop-sided.

EXAMPLE OF LETHAL WIRING

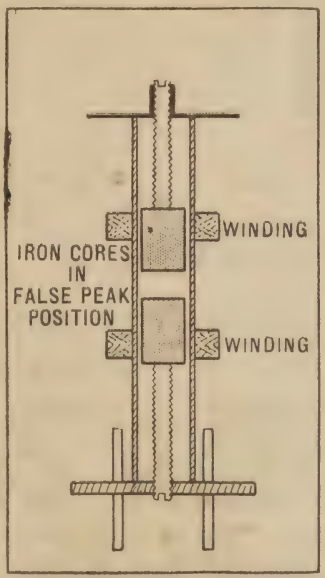


Mixing up the earthy and one active lead of the appliance gave very puzzling but very dangerous effects when used with a 3-pin double adaptor. Work out the

To be on the safe side, I always make a point of setting the slugs to the "full out" position before commencing adjustment, then selecting the first peak which appears as they are screwed in.

These transformers definitely gave the false peak effect, and, as I ad- justed each slug to the correct peak, the gain came up substantially, so that, by the time I had finished all four, the set showed promise of being a really good performer. Up to this point, I had feared that the extra gain of the X61M might cause instability, but the performance was perfectly smooth and I decided to leave things as they were.

There is not much point in trying to patch a broken dial glass, unless a new one is absolutely unprocurable. In this case, being a recent model, I had no difficulty in securing one from the manufacturers, and, when it was fitted, the alignment and calibration were completed. Then, after a gen- eral check on the performance, the chassis was given a final clean-up and re-fitted to the cabinet. In ap- pearance and performance it was now equal to a new set and it was a very satisfied customer who eventually took delivery.



Some IF transformers give a false peak effect with the cores screwed in rather than out. As a precautionary measure, always favor the outer position.

Since I had been well compensated for my labors, everyone was happy, except, perhaps, our budding "ham" who had been forced to sell so cheaply.

Another experience I had recently emphasises that an inexperienced person can not only gum up a com- plicated device like a radio set, but he can also create dangerous situa- tions for an even more complicated and valuable thing like the human body.

APPLIANCE LEADS

I suppose it's too much to expect that the man of the house won't con- tinue to replace damaged appliance cords, &c., but, if you are going to effect these repairs, for goodness sake learn how to do the job properly. After all, it is not difficult to do a good job, but a bad one may cost someone's life.

But, to get on with the story. I had been installing a new receiver and the owner had wanted an extension speaker and two outlets for it in different parts of the house. The wir- ing for these had called for much crawling in confined spaces and when the job was done I was damp, dirty— and thirsty.

The lady of the house must have realised this, for she proceeded to brew a pot of tea, following which she plugged in the toaster, apparently in- tending to prepare some delicate mor- sel to go with it. The details I shall never know, for the toaster refused to heat.

At this stage the plot thickens (as they say in the who-dun-its), for, while the failure of the thing itself was not surprising, the remarks which it brought forth certainly were. "Oh, of course," exclaimed the house- wife with an air of exasperation, "it's plugged into the wrong side of the adaptor." Whereupon she pulled it

MODERN VALVES NEED MODERN COILS

Australia's cheapest unit yet, for its type by far the most sensitive—less than 1u/volt on broadcast band and little more on short wave. Designed for high-stability and practical application. Available for most converter types.

R.F. DUAL-WAVE BRACKET

SPECIAL FEATURES INCLUDE

- Measures only 5½" x 2½" x 2¼"
- Lo-loss polystyrene former.
- Spherotune carbonyl tuning. (Exclusive to Q-plus).
- Spare contacts for gramo-switching.
- Available for 16-50M or 13-42M

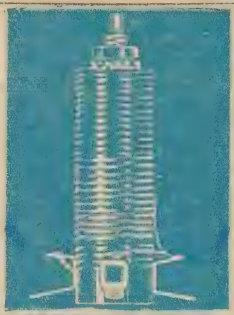
This is the specially shaped midget unit, designed to snugly fit between volume control and dial spindle. Available for all wanted converter valves, but only for 16-50M short-wave coverage.

SINGLE STAGE D.W. UNIT

SPECIAL FEATURES INCLUDE

- Measures only. 3¼" x 1½" x 2¼".
- Lo-loss polystyrene former.
- Spherotune carbonyl tuning (Exclusive to Q-plus).
- Single hole mounting.

At last a highly efficient short-wave coil—professional in appearance and performance. This unit uses a special high-frequency carbonyl powder core—small in size yet ample to align for stray inductances.



SHORT-WAVE COILS

FEATURES

- Lo-loss polystyrene former.
- Lo-loss polythene covered wire.
- Single hole mounting.
- Normally priced.

AVAILABLE ALSO UNWOUND FOR HAMS, ETC.

FOR BEST RESULTS WITH YOUR DUAL-WAVE UNIT INSIST ON Q-PLUS IF's

STANDARD

We recommend types I.F. 8 and 9—the exclusive "SPHEROCLAD" I.F.

With Opimum Gain and Selectivity Characteristics and Ceramicon Negative Temperature Condensers.

MINIATURE

Similarly constructed to the type 8 and 9—"Q Plus" miniatures — type Nos. 1 and 2 are recommended for all portable and miniature applications.

I.F. TRANSFORMERS

STANDARD

Definitely the best value available these "Spheroclad" coils have exceptionally high "Q" factors. Each unit has inbuilt top coupling condenser so necessary for uniform gain over the band

SIZE

9/41 Litz wound HI-Z primary, etc. Lo-loss base same construction for R.F. coils.

Oscillator coils to match. And for use with all converter types.

AERIAL, R.F. AND OSC. COILS

MINIATURE

No need to repeat the success of these units in car radios, portables, etc.

IMITATED BUT NOT EQUALLED

Please be sure you get the correct type—see opposite.

SIZE

RC1 normal midget R.F.
RC2 tapped (car radio type).
AC1 normal midget aer
AC2 tapped (car radio type).
O5 6SA7/6BE6 OSC.
O2 1R5 OSC.

SEE YOUR DEALER FOR OTHER DETAILS

AERIAL, R.F. AND OSC. COILS

MODERN COILS ARE "Q-PLUS" COILS

R. W. STEANE & CO. PTY. LTD., AUBURN, VICTORIA

out of one side of the two-way adaptor, plugged it in the other side, and the element glowed merrily.

"Is one side of the adaptor faulty?" I asked, wondering, if it was, why they used the thing at all.

"Oh, no, I don't think so," she replied, and then prattled on gaily by way of explanation, "but you see the toaster has to be plugged into the top socket or it won't work, and the iron is the same, only it has to be in the bottom socket, and it won't work when it is in the socket on the wall, but only when it is in the adaptor. It certainly is annoying when you put them in the wrong one."

I won't pretend that I was able to follow the technical reasoning behind all this, at the pace it was delivered, but I was quite sure that something very serious was wrong.

DANGEROUS CONNECTIONS

"It might be a good idea if I had a look at the toaster," I said, "and the iron, too. I'm afraid they might be dangerous." This announcement was received with a partial air of disbelief, but she hurried off to get the iron. An examination of the toaster cord confirmed what I had now begun to suspect, namely, that the connections to the plug were incorrect. One lead from the element was connected to the earth pin of the plug, while the frame of the toaster was connected to one of the active pins!

When the toaster was plugged into the top socket it so happened that the frame was connected to the neutral side of the line, while the element was between the active side and earth. This allowed the toaster to function and was reasonably safe, because the neutral side of the line is normally earthed.

However, when it was plugged into the bottom socket the position was quite different. Because of the way in which these adaptors are constructed, the connections to the mains are reversed, so the position now was: element between neutral and earth, and the frame to the active pin. This meant that no voltage was applied to the element, but that the frame was at 240 volts with respect to any convenient earth.

LETHAL EARTH

And when I say convenient earth, I have in mind that the normal working position for the toaster was only about two feet from the gas stove. I visualised a sleepy housewife, struggling with hubby's early morning toast and fried eggs, and having, literally, one hand on the toaster and the other on the gas stove. Need I say more?

I rewired the plug, checked it with the ohmmeter and finally tried it in both sides of the adaptor. All was well, so I turned my attention to the iron.

Much the same conditions prevailed here, with the frame connected to one of the active pins. However, in this case, it was the opposite pin to that of the toaster, so that the iron would only work when in the bottom socket of the adaptor. It was inoperative, and dangerous, when in the top one, and also when plugged directly into the wall socket.

I learned, upon inquiry, that the usual position for the ironing board was between the gas stove and the sink, "Handy to the tap when you want water for damping down, you know," explained the housewife.

I shuddered.

Having rewired the iron plug, I checked the remaining appliances, and then tried to explain just how dangerous the situation had been. Whether I succeeded or not, is hard to say, but I did have the feeling that there was going to be a certain amount of domestic strife when hubby arrived home that night. Ah, well, better that than a corpse!

Now just what are the important points when fitting a new cord or plug? First, you should realise that a three-way cord and three-pin plug are provided in order that the frame of the appliance may be earthed. This is a safety precaution, in case the insulation between the element and the frame should break down. With everything as it should be, such a breakdown will not only be rendered harmless but will usually blow a fuse, thus drawing attention to the fact that all is not well.

When you come to do the actual job make quite sure that you can identify the earth connections on both the appliance plug and the three-pin plug to go in the wall socket. The appliance plug is usually self evident, as contact to the frame of the appliance is generally made by means of a spring pressure contact on the outside of the plug.

The position of the earth pin on the standard three-pin plug is rather hard to describe in print, but it should be quite evident from the accompanying sketch. In any case, I have yet to see the plug on which this pin is not clearly marked.

The three-way cable is usually color-coded, the standard combination being red, black and green. The green wire should be used for the earth connection, since this is the accepted practice. If any other color is used there is a danger that someone else may fit a new plug the wrong way round. But the vital point is never to take the color code for granted. Always check where each individual wire comes from and goes to!

BARING WIRE

Make sure that no more wire is bared than is necessary to go under the connecting screws, that these screws are tight and that any strain relieving devices in the plug have been made use of. Finally, try to provide some form of simple continuity tester, such as a torch battery and lamp, and check that the two earth pins are really connected together.

Above all, if there are any queer effects like those in the case I have just described, leave well alone until you can have the position checked by a competent mechanic. After all, as the cartoonist says, "Death is such a nuisance!"

REGULATED POWER SUPPLY DESIGN

(Continued from Page 45)

wound potentiometer for the voltage output adjustment and fixed carbon resistors (R5 and R6) above and below it to complete the total.

The exact values of these for any particular regulated supply are most easily determined experimentally by substituting a 25 megohm potentiometer temporarily in place of R1, R5 and R6. Then, with the supply operating, the settings of the potentiometer tap for the minimum and maximum output voltages allowable under full load conditions can be determined.

The potentiometer is then disconnected and the resistances measured with an ohmmeter. The risistance between the slider position for low voltage output and the ground end of the "pot" is the value for R5. Similarly, the resistance measured between the slider setting for high output voltage and the "hot" end of the potentiometer is the value for R6. The correct value for R1 is then R5 plus R6 subtracted from .25 megohm.

Standard power supply wiring practices apply to all portions of the regulated supply except the control tube section. Since this tube is acting as a high gain DC amplifier, it is very susceptible to hum pickup which will appear as ripple in the output voltage.

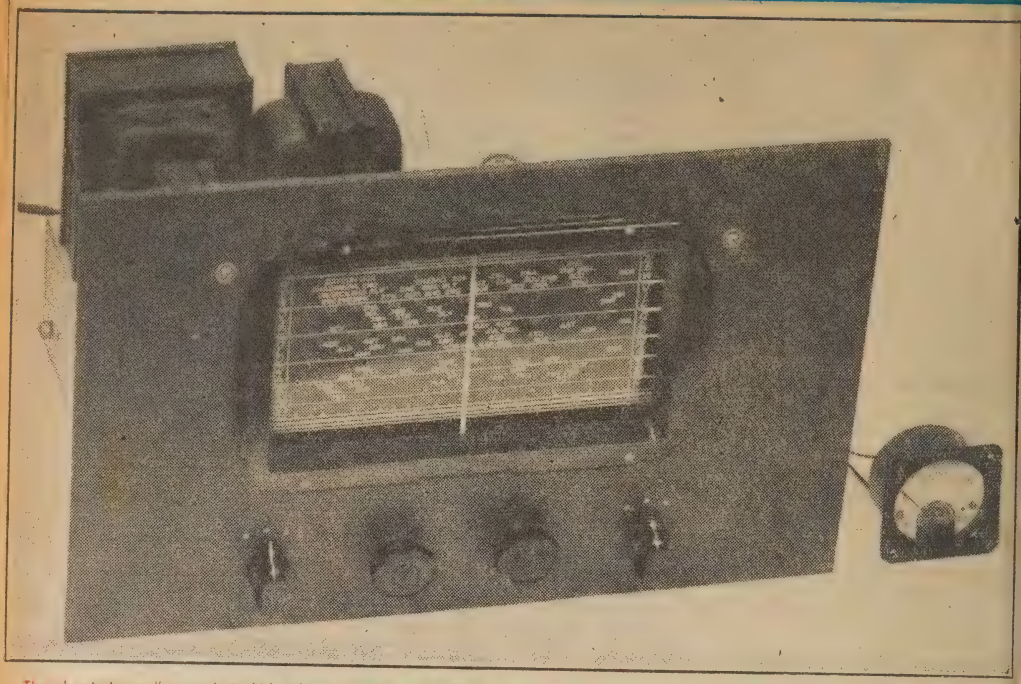
To minimise this, all leads associated with the control tube, and especially the grid lead from R1, must be as short as possible. The best practice is to mount the voltage control potentiometer adjacent to the control tube socket at a location as far as possible from the power transformer, filter chokes, filament transformers, and other components which produce hum fields.

A chassis layout which is suitable for the design discussed above is shown in Fig. 4. All parts are mounted on a 7 x 11 x 2 inch metal chassis. Well-shielded components should be used and all a.c. leads must be twisted in pairs to reduce hum radiation.

A separate filament winding is required for the regulator tube since the filament of this tube is operated at the full supply output voltage above ground.

When the special 6AS7G pass tube is used, this precaution is not necessary because the heater-cathode insulation in this tube is sufficient to withstand 300 volts.

The completed supply should be checked for satisfactory regulation by varying the load current from the full design rating to zero. Under these conditions, the change in output voltage should be negligible. Ripple content can be checked qualitatively with earphones coupled through a suitable condenser, although an oscilloscope is very much preferable.



The chassis is small enough to hide almost completely behind a small panel. Control at left is the Record-Playback switch. Then comes the volume control, then tuning control, and finally the Radio-Pickup-Microphone switch to select the input. To the right is the 0-1 milliameter used as a level indicator.

THE R & H JUNIOR RECORDER

This comparatively simple unit fulfils our promise to describe a radio-gramophone-recording unit which will give really high class results at reasonable cost. Although as a radio-gramophone it is in the true high fidelity class, main interest is focused on its ability to produce microgroove recordings from pick-up, radio or microphone. These are almost indistinguishable from the original material.

by John Moyle

READERS who have been following recent articles on microgroove recording in the home will remember our enthusiasm some months ago when these facilities were added to a standard recorder available on the Australian market.

Since then, we have spent many months of experiment and measurement, gradually improving matters until now we are ready to describe a design anyone can build.

The task may be divided into two parts—first to design a radio tuner with wide-range characteristics to preserve the maximum high-note response, and secondly, an amplifier which, while suitable for playing ordinary records, will fulfil the special requirements of the cutting head when making records.

The amplifier thus had to accommodate radio pickup and microphone inputs, either for speaker reproduction, or for recording.

Let us describe the radio tuner, and the reasons for building it according to our circuit.

It is common knowledge that the ordinary superhet. tuner is too selective to allow the top end of the musical scale to penetrate its sharply-tuned intermediate frequency channel. Although results are acceptable for ordinary listening, they fall short for wide-range reception.

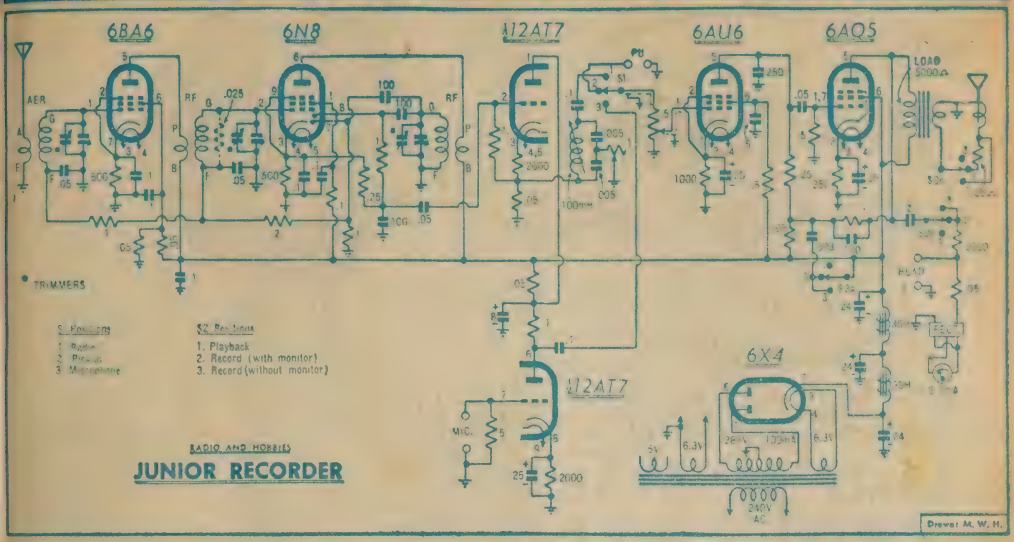
A tuner was required, therefore, which would be simple, but which would not unduly cut down on high frequency response. Not only do we require the high notes for good listening, but they are essential for record-making, where the chief problem is to preserve high frequency response. No good going any further in recording programs if the high notes are not there in the first place!

Superhets can be made to have a wide enough band acceptance for the purpose but they are not easy and because of their special alignment, are generally beyond the capabilities of the ordinary man.

We fell back, theferore, on the straight TRF tuner which, of its very nature, is much less selective than the superhet.

After all, as only the local stations are required, selectivity need be only

CIRCUIT DIAGRAM OF THE R&H JUNIOR RECORDER



The wiring to two switches may complicate circuit appearance but the set is really quite a simple one. A good quality output transformer is almost essential for good results.

good enough to separate these stations, and allow their reception at good volume. The TRF tuner is quite adequate for this service. In fact we can even afford to load its tuned circuits with resistors to reduce selectivity still further for the widest possible band acceptance without inter-station interference.

The curve we are trying for is really one which has a flat "top" allowing reception up to 10 kc, and steep sides to reject any stations or noise outside this region. The TRF isn't ideally flat in this sense, and it sides or "skirt" aren't very steep either. That's where our special superhet might score. The TRF is quite simple to build, and will give an acceptable approximation of what we require. So much so that one can immediately detect the difference between such a tuner and an ordinary superhet by observing its extra brilliance and overall clarity.

MINIATURE VALVES

At this stage we made a decision to use miniature valves so that the whole unit could be kept small. Some may wish to mount it with the recording motor in a portable case for carrying, while others will undoubtedly mount the whole thing in a large cabinet (but without the speaker, we hope!). While standard valves performing equivalent duties could be used with equal success, the small valves are somewhat less prone to microphonic troubles, particularly when using the microphone, and their higher gain characteristics are sometimes an advantage.

As it is, the unit will fit beneath the recording unit without fouling the turntable or its driving motor. A smallish tuning dial was used for the same reason.

Having settled the valves, we chose the 6BA6 as the first RF amplifier, and the 6N8 for the second, it being the only smallish valve having diodes as well as a pentode section. One of these diodes is used for detection, and the other for AVC.

The tuning coils are standard types, as also is the gang, although we preferred the physically smaller sizes again for compactness. Larger types would do as well.

The miniature valves have very high gain which might cause oscillation over two stages unless bias resistors of higher than normal value are used. In our set, there was a slight tendency toward oscillation at the low frequency end of the dial. Naturally, this wasn't important when tuned to the strong locals in the vicinity, but it disappeared completely when one or more of the tuned circuits was resistor-loaded to decrease selectivity.

In our circuit, we found that loading the centre coil was all we could afford without danger of station interference, as the unit is operated within sight of all but two Sydney stations. If you can load all the circuits without interference, so much the better. The limit will be reached when selectivity is too poor, or gain at any spot on the dial is too low. As a rule, 25,000 ohm resistors

PARTS LIST

- 1 Chassis 11" x 9" x 2¾"
- 1 Power transformer
- 2 Filter chokes
- 1 High quality output transformer
- 1 Dial to suit gang (USL 32 or similar)
- 1 Aerial coil
- 2 RF coils
- 2 3-pole, 3-position, single gang switches
- 1 100 mH. coil (See diagram)
- 1 Microphone plug and socket
- 1 Speaker
- 3 7-pin miniature sockets, 2 9-pin miniature sockets, 1 Octal socket
- 1 meter rectifier
- 1 0-1 milliamp meter

VALVES

1 6BA6, 1 6N8, 1 12AT7, 1 6AV6, 1 6AQ5, 1 5Y3-GT

CAPACITORS

- 1 3 section gang (AWA or Stromberg.)
- 3 Trimmer capacitors
- 2 100 pf mica
- 1 250 pf mica
- 1 .003 mf mica
- 2 .005 mf mica
- 2 .05 mf 200VW
- 2 .05 mfd 400VW
- 1 8 mf 525V electrolytic
- 3 24 mf 525V electrolytic
- 3 25 mf 40PV electrolytic
- 2 .1 mfd 200VW
- 5 .1 mf 400VW
- 2 .1 mfd 400VW
- 1 2 mfd 400VW

RESISTORS

- 1 25 ohm 3w
- 1 250 ohm 1w
- 2 500 ohm 1w
- 1 1000 ohm 1w
- 3 2000 ohm 1w
- 1 .025 meg. ½w
- 6 .05 meg 1w
- 3 .1 meg ½w
- 2 .1 meg 1w
- 1 .25 meg ½w
- 1 .1 meg potentiometer
- 1 .25 meg 1w
- 1 .5 meg ½w
- 1 .5 meg 1w
- 1 .5 meg potentiometer
- 2 1 meg ½w
- 1 2 meg ½w
- 1 5 meg ½w

SUNDRIES

Knobs, terminals, tag strips, power flex, hook-up wire, shielded hook-up wire, solder lugs, nuts and bolts etc.

YOU HAVEN'T HEARD . .

—until you've heard your equipment with the NEW

B-46-D CRYSTAL MICROPHONE

B - 46 - D "AUDIO - CELL" MICROPHONE

GOOD SOUND REASONS

- **FLAT FREQUENCY RESPONSE** Total variation less than 6db between 40-8000 c.p.s.
- **HIGH IMPEDANCE** Direct connection to grid circuit of amplifier—no transformer required.
- **HIGH OUTPUT** Sensitivity—50db referred to 1 volt/dyne/cm2.
- **ACOUSTIC FILTER** New acoustically treated interior filter stops wind and breath blasts. Eliminates wind rumble in outdoor pickup.
- **ECONOMIC INSTALLATION** No polarising voltage required.
- **NON-DIRECTIONAL** "Live" area around entire circumference.
- **HERMETICALLY SEALED** Unaffected by temperature changes or climatic conditions.
- **VERSATILE** Equally suited for either close proximity use or distant pickup—indoors or out.
- **EASY MOUNTING** Handle threaded for mounting to stand—stand available at slight extra cost.
- **ROBUST** Spherical screen casing fully protects element.

ATTRACTIVE design and precision workmanship put the B-46-D in the "luxury" class at an **economic price.** Ask your dealer for the B-46-D. Its outstanding performance, attractive oxide finish and discreet decoration will enhance any equipment. Ideally suited for every application where a high degree of fidelity is required—from outdoor P.A. work to the most elaborate studio installation.

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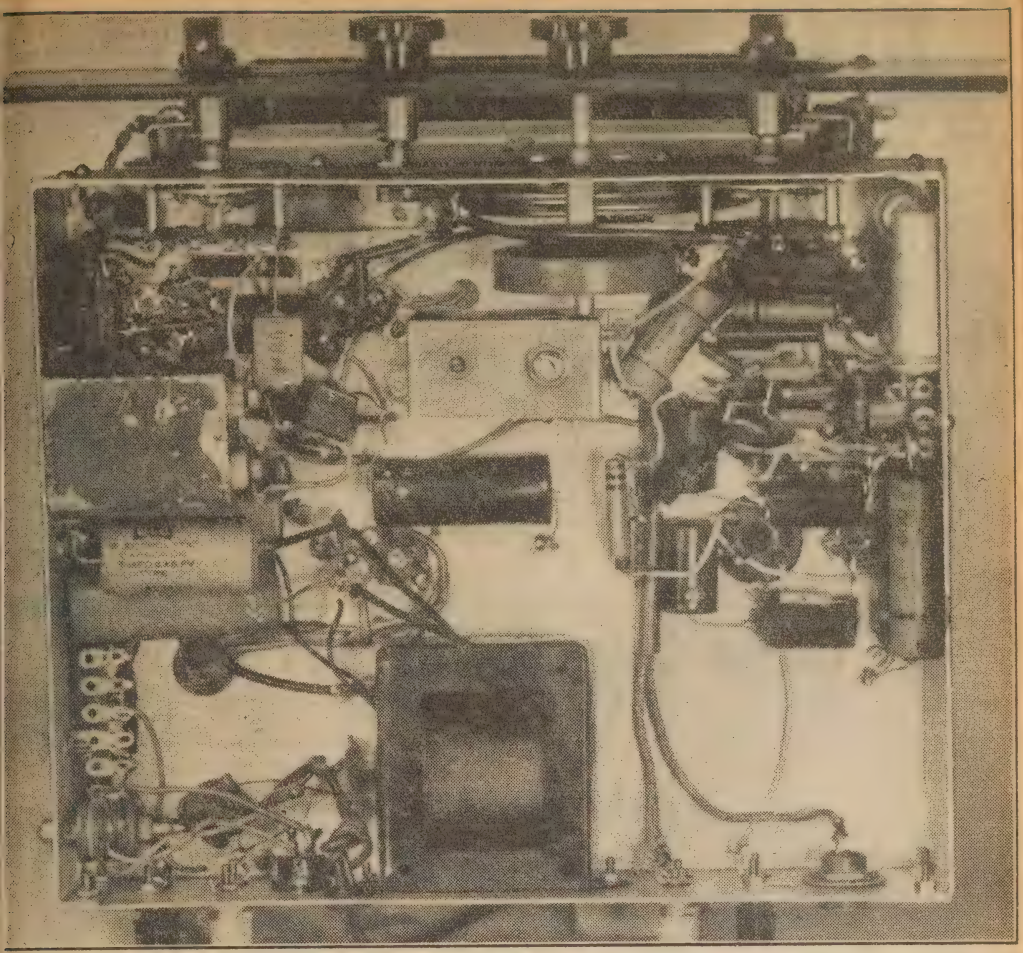

This picture shows component placement. Note the whistle filter behind the dial flywheel. The AVC bypass condensers and decouplers are seen near the centre. The second filter choke could be mounted above the chassis. Output terminals from left to right are Loudspeaker, Cutting head, Aerial and Earth. Pickup. Switches are so placed to keep leads to them short.

will suffice, but lower values can be used if they do a better job. Your own discretion is the best guide, and if in doubt, follow our circuit.

The AVC circuit is straightforward and needs no comment.

Now we come to the detector circuit, with which is associated the 10kc whistle filter. Any wide-range set such as this is liable to reproduce a high-pitched whistle on some stations, due to inter-action between their carriers and other remote but strong stations on an adjacent channel. As the separation of these stations is 10kc, this whistle is always of this frequency (which, of course, is audible) and it can be quite strong enough to ruin reception.

Our aim, therefore, was to work out a filter which would remove a narrow portion of the audio spectrum (maximum attentuation being at 10kc) and sufficient to eliminate the whistle.

The filter shown, which is of the Bridged-T type for those who are interested, does this most effectively. It is simply a coil of wire wound on a bobbin, and tuned with an iron slug taken from an old intermediate transformer. The coil is resonated to 10kc by two fixed condensers in series, from the junction of which is connected a .1 meg. variable resistor to ground.

SLUG-TUNED

In practice, the coil is lined up by the slug. The resistor controls the degree of attentuation, and must be adjusted by experiment. It is quite critical, but when correctly set, wipes out the whistle like magic. We will have more to say about it when considering adjustments.

Unfortunately, the filter cannot be connected directly to the diode, which represents a high resistance circuit. As the filter resistor peaks at about 40,000 ohms, this value, in series with one of the .005 mfds condensers, operates like a permanent tone control. It was therefore necessary to devise a low impedance circuit following the diode having a value much lower than 40,000 ohms, so that the shunting effect of the "tone control" would be negligible.

This is done by connecting a cathode follower immediately after the diode. Without going into the theory of the cathode follower, we would say that its input circuit has a very high impedance which avoids shunting the diode load. On the other hand, its output or cathode circuit has an extremely low impedance —only a few hundred ohms. This is ideal for feeding the filter. In fact, we had thought it would be low enough to spoil the latter's sharp attentuation, but in practice, this was

UCC

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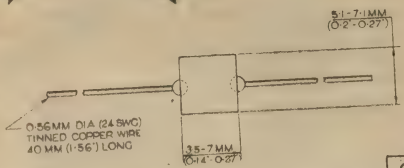

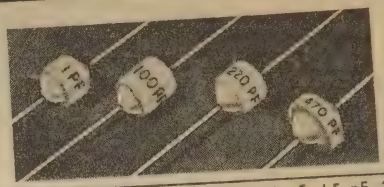

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TOLERANCE OF CAPACITANCE ..	Guaranteed not less than —20% of stated values at 20° C. (on values 3.3pF and above). Nom. capacitance below 2.2 pF. Test conditions 10V. RMS. at 130 Kc/s.
INSLN. RESISTANCE	Greater than 5,000 Meg. at 1,500V. D.C.
WORKING VOLTAGE	500 Volts D.C. or 250V. RMS. A.C. 20 CPS.-60 CPS.
TEST VOLTAGE ..	1,500 Volts D.C.
MARKING	Capacitance red ink on white ground.
NOTE	Dimensions shown are for capacitors with Finish "C," Finish "A" increased overall dimensions by approx. 2 M.M., and Finish "E" by approx. 1 M.M.

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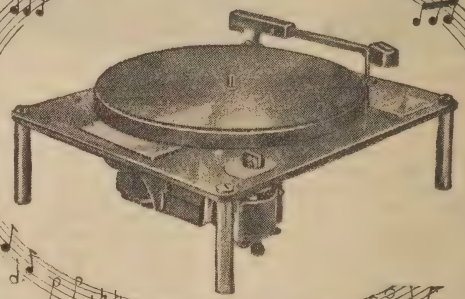

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ot so. The total bandwidth affected by the filter is actually only bout 400 cycles. The absence of his small frequency band is of no ractical consequence to our results.

The cathode follower valve is one alf a 12AT7, a twin triode valve, he other half of which is employed s a microphone amplifier. In this ervice its high gain—amplification actor of 50—is very handy. As the wo halves are never used simulaneously, there are no problems of nter-action between them. In fact ve used the same decoupling circuit or each for the same reason.

FILTER UNIT

The filter is made up as a small nit. The screw thread for adjusting he iron core runs through the base, nade of about 16 gauge steel. This nay be tapped to take the thread but n our case we soldered a brass nut o the base to serve a similar purpose. The slot adjustment thus projects hrough a hole in the chassis, nd is set from above. The resistor —actually a potentiometer using only wo connections—is adjusted from elow the chassis.

Placement of this unit is important to avoid hum pickup from the power supply by the coil. The layout shown is quite satisfactory, but he whole unit could be enclosed in a small steel box if the extra metal work isn't a problem.

We can now consider the switching arrangements for the input to the amplifier. As there are three circuits to be switched in turn to the volume control, a 3 x 3 wafer switch is used, only one set of contacts being needed.

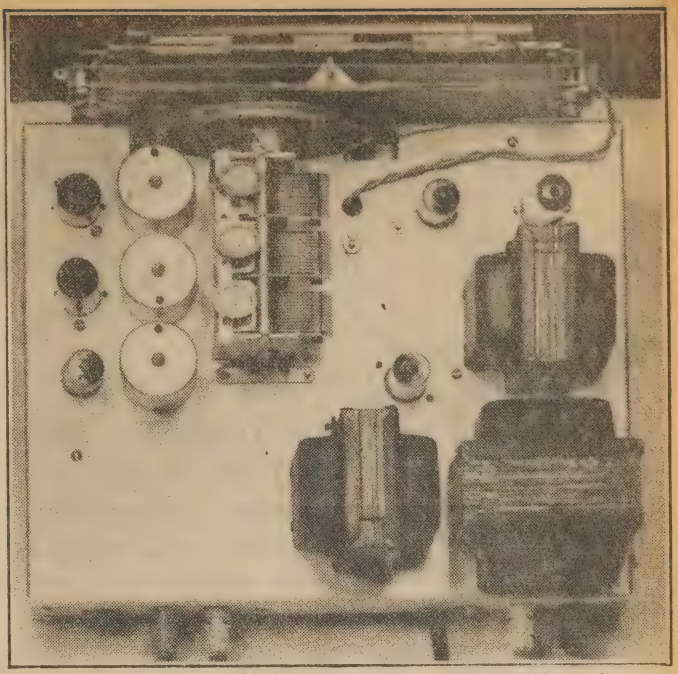
The "common" contact of the switch runs to the volume control and each of the three remaining contacts is connected to the filter unit, the pickup terminals, and to a coupling condenser from the pre-amplifier. Thus all three can be used either to record or to play through the loudspeaker.

There are quite a few parts to be fitted into the tuner section of the chassis, but by using small mica condensers and half watt resistors, suitably supported on terminal strips, the job can be done without too much trouble. Keep grid and plate leads spaced as far as possible, and the leads to the diode and AVC line as short as you can. Both are precautions against oscillation in the tuner. Small electrolytics are available in both 25 and 8 mfds types, the latter being English and of midget proportions.

REQUIREMENTS

In designing the audio amplifier, we had two opposing requirements in mind. First there was the loudspeaker, requiring a circuit with plenty of feedback for low distortion and low source impedance. This is quite easy to arrange, and we accommodated it by using a divided network across the load, and feeding the pentode plate resistor into this point.

Feeding the cutting head is quite a different problem. Here we have a load in which the impedance varies from a few hundred ohms at low frequencies to many thousands of ohms at high frequencies. To feed this cutter from a low impedance source would result in humped response around about 1500 cycles or so, and a rapid attenuation from there upward.



This above-chassis view shows the tuning section at the left—amplifier and power supply at right. Output transformer is immediately behind the 6AQ5, located upper right. The slotted screw adjustment for the filter slug projects through the chassis near the gang condenser.

What we needed was a circuit giving a low output impedance at the low frequencies, and a rising impedance at the high end to keep pace more or less with that of the cutter. This would have the effect of increasing the voltage fed to it as the frequency increased, thus holding up the high frequencies.

VARIOUS CIRCUITS

This is particularly important because all cutters of this type tend to fall off rather badly above about 2000 cycles. In the past, we have used various types of resonant circuits and filters to combat this tendency, but as the characteristics of cutting heads—even of the same make—tend to vary quite a bit, we wanted some method which would be virtually independent of individual adjustments, and which would, if possible, be more or less independent of the natural resonance of the cutter.

In actual practice, tailoring the source impedance of the amplifier is the most important single method of achieving good high frequency response, and we decided to work along these lines.

Our first effort was to use current feedback on the output valve instead of voltage feedback, obtaining this effect by using unbypassed resistance in the output valve cathode circuit. This improved results a good deal, moving the hump further up the scale, but still allowing a too severe attentuation of high frequencies. Current feedback, of course, allows the source impedance represented by the valve to remain high, so that we had merely substituted a high impedance for a low one at all frequencies.

Our final circuit uses a well-known method of voltage feedback, in which the smaller of the two resistors determines the feedback percentage. By connecting across this resistor a suitable value of capacitance, the feedback can be gradually removed, commencing at a frequency determined by the condenser value.

As the feedback is removed, the output and the source impedance for the cutter both increase, until at some position in the high frequency end of the scale it may disappear altogether.

FEEDBACK

By using a large amount of initial feedback, the point at which feedback ceases moves higher up the scale. We did not measure exactly where this occurs, but it would be well up into the useable portion.

The net result is that we now have a circuit the source impedance of which automatically rises with frequency in the way we require, and which therefore provides a better impedance match for the cutter. It would be difficult to establish how nearly the two curves agree, but its is sufficient at this stage to know that they both travel in the same direction at about the same rate. We

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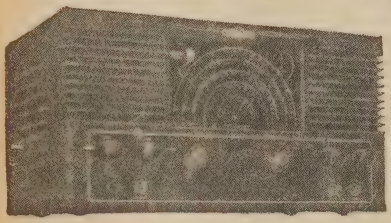

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are not now interested in complicated circuits to do more than this.

Across the larger of the two resistors is connected a second capacitor, of much smaller value than the first. This is to prevent the feedback from being removed altogether, which would tend to increase upper harmonic distortion with possible bad effects. Testing with a square wave input, high transient voltages were observed with the cutting circuit, undoubtedly due to the removal of feedback. This extra condenser reduced these little pips quite materially, and the value given does not noticeably reduce high frequency response.

FILTERING

Incidently a recording of this square-wave-form showed no trace of the transients referred to, indicating that there is a further mechanical and possibly electrical filtering identified with the cutting head which makes the matter one of more academic than practical interest. It is quite important, however, that the amplifier is not liable to be set into oscillation by sudden signal inputs, and it is worth guarding against this.

Tests with this circuit gave quite the best results to date. The high frequency response is now quite good—so much so that recordings of radio programs are virtually indistinguishable from the original broadcasts. There is plenty of life and bite in the brass and cymbals for instance.

A Xmas tree pattern record made of the cutter showed a peak at about 4 kc (1 kc reference)—probably due to the natural resonance of the cutter, but not large enough to be serious. At 6 kc the output was still at reference, and even at 8 kc the response was still appreciable.

It was slightly down at 7 kc, and beginning to fall more seriously at 8 kc. At 10 kc there was enough to be heard quite easily on playback, although at greatly reduced amplitude.

BASS END

So much for the top end. Below 1 kc the main aim is to achieve a suitably graded "roll-off" commencing at about 250 cycles. The cutter, of course, must be fed via a blocking condenser against the DC, and this value must be high enough to control good bass response.

Unfortunately, at least 2 mfds is needed for this purpose, and this value, in series with the inductance of the head, provides a resonant circuit giving a rise in output at about 400 cycles. This imparts a rather objectionable boominess, particularly to voices.

It is possible to reduce the effect almost entirely by connecting a resistance in series with the cutter. This has the effect of lowering the "Q" of the circuit, and thus flattening the resonance.

This resistor will absorb some power, of course, but not so much as to starve the cutter.

Our Xmas Tree pattern now looked quite good, and probably as good as it could be made without prejudicing simplicity.

When switching from the "record" to "playback" position, there are three circuits to consider with three switching positions. Thus a standard 3 x 3 wafer switch can be used.

The first circuit obviously concerns the cutting head, which must be switched in and out. The second concerns the feedback which is resolved to a simple matter of connecting and disconnecting the .003 mfds. condenser. The third circuit is to the loud speaker. In the first of the playback conditions, a resistance is connected in series with the voice coil to reduce the amount of power fed to it while still allowing the speaker to be used as a program monitor. In the third switch position, the speaker is switched out of circuit altogether, thus allowing the microphone to be used in the same room as the equipment without acoustic feedback.

The value of voice coil resistor will vary according to the voice coil impedance. About 25 ohms is right for a 2.3 ohms speaker, but a considerably higher resistance may be needed for higher voice coil values. Actually there is no point in allowing more power to be used up by the monitoring speaker than is absolutely necessary to let you know what is going on.

The level indicator meter which comes into operation in the record position is absolutely necessary for the best results. If the full cut is to be applied to the records without overload or distortion, you must have an indication of level. It is almost impossible to estimate this accurately by listening to the monitoring speaker.

LEVEL INDICATOR

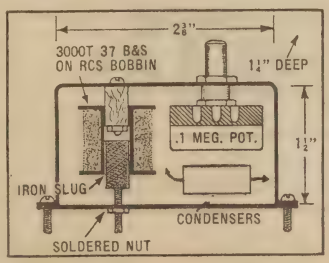
The meter is an ordinary 0-1 milliameter fed through a metal rectifier from the cutting head. A proper meter rectifier is best although an ordinary disposals type works quite well. Its frequency characteristics may not be as good as the regular type, but one soon gets used to either in practice.

In using the meter, experience soon reveals the maximum peak deflection allowable without overcutting the grooves, and the safe average reading which will protect against these peaks. Overcutting will result in distortion on playback, modulation from one groove into the next, and even breakdown of the record material between the grooves.

It should be possible to obtain full, clear modulation without any signs of distress, provided you have a sharp cutting stylus, and have adjusted the cutting depth correctly.

We have treated the meter on a plug-in basis, as an AC multimeter for instance can be used quite well, thus avoiding buying one specially for the purpose. The 50 or 100 volt scale should be used in this case.

The well-known ex-disposals 0-5 milliameter we have used in the past isn't the best in this circuit, as



Here is a diagram of the whistle filter unit.

THESE MEN HAVE HEARD THE RECORDER

IN order to judge the reaction of our readers to our new recorder, we invited four men to hear some of its results, and to write down in their own words what they thought of it. This is what they said.

C. W. (Business man) I had no idea that such fidelity could be obtained from microgroove records made at home, nor for that matter from any home-made records. To me they sound just as good as the original. Those I have heard are really beautiful.

G. N. (An experienced radio engineer) The equipment combines compactness, simplicity, non-critical adjustments, and ease of control—an excellent arrangement. The results generally were most impressive, comparing very favorably with those obtained from much more elaborate professional equipment. Noise level was very low, and response appeared to be smooth and free from objectionable peaks, extending well into the LF and HF regions. Harmonic distortion was hardly detectable and hum level below audibility. With good material, it was a pleasure to relax and enjoy the performance, enhanced in no small measure by the long playing feature.

J. S. (Solicitor) Many thanks for letting me share a musical treat. I had developed a sceptical attitude towards disc recording gear, with the thought that records would be no good as regards tone and quality generally. Frankly, I was surprised. You certainly have something there. Tone and frequency range are very pleasing, and I was astonished to realise how easy it is to make good recordings with such equipment.

C. S. (Business man) I was delighted to hear your recording outfit and to compare for myself the normal 78 rpm with microgroove. I am thoroughly convinced that results are in no way inferior and noise level appreciably lower with microgroove. Reproduction was very clear—high and low note response well balanced, with a volume level greater than I expected. To me it appeared to reproduce very faithfully whatever material was being recorded, and I am certainly going to build one.

All four men have long been interested in amplifiers and records, and all have had constructional experience with them. They were assured that no matter what their reactions were, good or bad, they would be printed.

They have spoken for themselves.

The Editor.

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the series resistor required is of low enough value to present an undesirable shunt on the cutter. In no case should the meter series resistor be lower than about 50,000 ohms in value.

The power supply requires particular attention, for hum is something which cannot be tolerated in the output of a high quality receiver, and particularly in a recorder.

As a result, a double section filter we consider essential for good results coupled with three large-sized filter condensers. The job when finished is almost completely humless. You have to get down on the floor against the loudspeaker to hear any hum at all.

The type of feedback means that decoupling cannot be used in the 6AU6 plate circuit, another reason for good filtering.

POWER SUPPLY PLACEMENT

Placement of the power supply is also important. We have grouped it well over to one side in a rear corner of the chassis well away from the microphone input circuit, and used upright components. This is a most important point, particularly with a steel chassis. With a flat mounting transformer, there will almost certainly be eddy currents set up in the chassis, and these can cause hum in all kinds of ways. By keeping particularly the transformer raised off the metal, a big improvement is effected.

In this respect, it's a good idea to enclose the shielded input leads in spaghetti to allow earthing of the braid at one point only. Experiment with earthing points is a good thing — often well worthwhile if hum should be detected on input leads.

The microphone amplifier has been neglected so far in our story, but needs little comment. It is meant to operate with a crystal microphone of a type now available, having quite a good response from 50 to 8000 cycles. The pre-amplifier gives plenty of gain from such a microphone for vocal and instrumental work.

Concerning recording, this unit has been designed with the use of microgroove in mind. There is enough output to make good 78 rpm records, but except for special purposes, we cannot imagine anyone wanting to make them. Microgroove plays longer, has better quality, and saves enormously on the cost of discs. The sapphire cutter is more costly, but it lasts a long time, and other savings more than pay for it.

To adust the whistle filter, tune to a station on which the whistle is most pronounced, detuning a little to one side if necessary to accentuate the effect. Adjust the iron slug, swinging the potentiometer backwards and forwards as you do so. If all is well, you will come to a point at which the whistle begins to decrease.

The procedure now is to tune the slug to find the point of minimum response, and to adjust the resisto having found this point, to attentu ate the whistle as much as possible A little experiment with these tw settings will enable you to remov the whistle altogether, or to reduc it so much that it can scarcely b heard.

The coil adjustment isn't parti cularly sharp, at least in the initia stages of adjustment, but the resisto is quite critical for its maximur attenuation. On this point a fe minutes practice is, however, wort a page of instruction.

LINING THE SET

Lining up a TRF set is fairl simple. The dial is first set t correspond with a station at th low frequency end. The coil slug are now adjusted until this station i tuned in at this setting.

Now line the dial with a statio at the opposite end of the scal This time adjust the trimmers to re ceive the station at this point. G back to the first station and chec once more on the setting of th slugs, and finally, back to the trim mers in case they have been throw out slightly by adjusting the slugs.

Incidentally, this equipment ha been designed to operate with th Byer Junior recorder, and the Acd GP20 crystal pick-up. It will pro bably apply more or less to othe types of recorders but for the sak of simplicity we have kept to th crystal pick-up as being particularl suitable.

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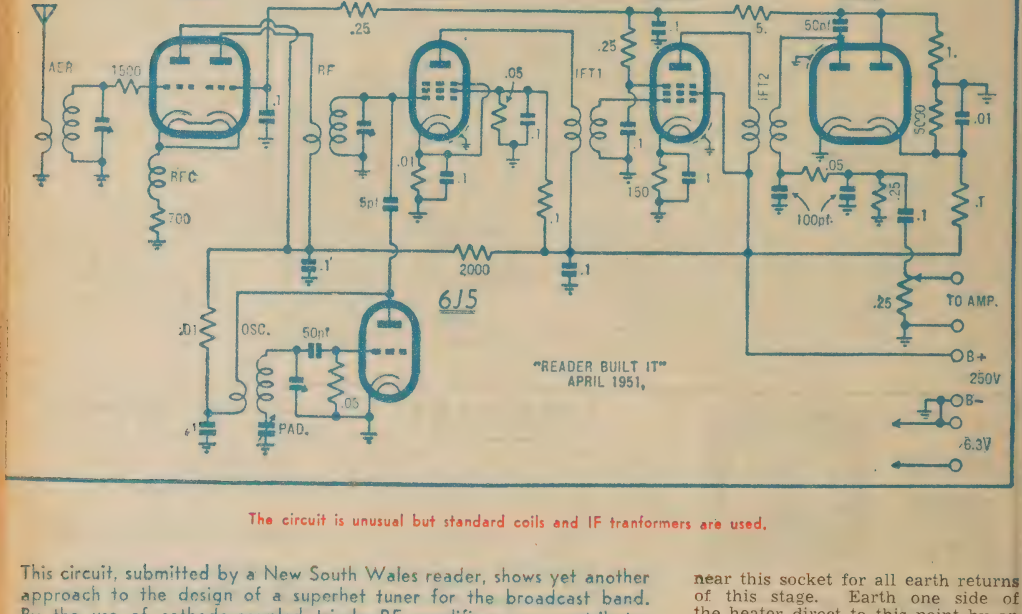
NOVEL SUPERHET TUNER WITH TRIODE RF STAGE



The circuit is unusual but standard coils and IF tranformers are used.

This circuit, submitted by a New South Wales reader, shows yet another approach to the design of a superhet tuner for the broadcast band. By the use of cathode-coupled triode RF amplifiers, our contributor claims lower set noise for the country user.

THIS design is the "brain-child" of Mr. N. G. Shaw, B.Sc., of the New England University College, Armidale, NSW. Mr. Shaw has applied to the broadcast band a technique usually reserved for the VHF and VHF bands, but using conventional valves in the RF stage and the mixer stage. Results are claimed to be extremely good.

In the RF stage, a 6C8 twin-triode valve is employed with the first half operating as a cathode-follower feeding into a grounded-grid RF stage in the other half. Other twin-triode valves could be used, of course, but the 6C8 is a good choice from the standard octal-based types.

The plate voltage feed to both sections is decoupled from the main high tension line by the 2000 ohm resistor and a .1 mfd capacitor. Cathode bias is provided by the 700 ohm resistor in the common cathode return. It is to be noted that this biases the first section only, the grid of the second section having no direct DC return to chassis. This second section is biased by voltage developed on the AVC line from one half of the 6H6.

The 6AC7 mixer with a 6J5 triode oscillator will be familiar to readers interested in communications receivers. Such an arrangement gives fairly high conversion transconductance as well as being excellent in regard to noise characteristic.

Use trimmers on each section of the 3-gang tuning capacitor to permit circuit alignment at the high frequency end.

The use of the EF50 in the IF stage contributes to a great extent to the overall gain of the tuner. Some care would need to be taken with the wiring of this stage, to realise as much gain as possible consistent with stable operation.

Use a single point on the chassis near this socket for all earth returns of this stage. Earth one side of the heater direct to this point by an individual lead. Similarly treat the earthing of the internal shield, the valve shield can and the centre spigot of the socket. See that the metal key of the valve and all pins make good contact with the socket.

If, after all precautions have been taken and your particular layout is still leading you into trouble, increase the value of the cathode bias resistor.

DETECTOR

The circuitry of the 6H6 detector and AVC source is quite straightforward. The detector output should be sufficient to drive a standard amplifier. Actually, a high-gain output pentode driven directly from the diode load should give a good account of itself.

In the detector diode circuit, the .25 megohm restor and the .1 mfd capacitor could be omitted and the .25 megohm potentiometer wired as the diode load resistor.

The delay for the AVC diode is obtained from a voltage divider connected across the HT supply and should be sufficient for normal use.

AN AC INVERTER

(Continued from Page 41)

entry by a small single-hole mounting half-clamp to prevent any flexing from being transmitted to the connections in the wiring.

Finally, a piece of bakelite sheet, 1/8 or 3/16 inch, is cut to size, bevelled and attached to the lid which carries the power socket and the switch to dress up the background for these items and to cover up a few odd holes in the lid. The bolts holding these items should be cut off close to the nut so that there is no chance of their piercing components.

The nuts on the 3/16 inch bolts are then adjusted so that there is about 7/8 inch clearance between the inside mounting plate and the inside of the lid. If you want to be wary, you could line the inside of both lids and the sides of the main case with light card or heavy paper.

ON LIGHT LOADS

Well, that completes the story with the exception of the remarks concerning the reduction of the output voltage for light loads.

For light loads on the unit of the order of 10 to 15 watts, it will be necessary to insert a small value of resistance in series with the input from the accumulator to drop the output voltage to around the 240 volt mark.

A value of resistance of about .25 ohm should be close to the mark. This can be made up by consulting the standard wire tables, selecting a gauge of wire which you have on hand or can obtain easily and winding an appropriate length onto a bobbin or a short length of wooden dowel.

Do not use too light a gauge as it will warm up appreciably from the flow of current. About 30 feet of 19 B & S or about 32 feet of 20 SWG should do quite nicely for the 6-volt unit. Resistance values for the 12-volt unit are shown in the diagram.

SELECTIVITY

A likely place to mount the resistor is near the dual-interrupter on that side of the internal mounting plate. It can then be connected into circuit between the RF choke and the switch, an additional tag on the 7-tag mounting strip being brought into use for anchorage of the connections.

And, finally, a word to the unsuspecting. This unit is not suitable for operating such comparatively high consumption devices as toasters, irons or radiators. It can, however, cope with a standard 240 volt AC 40 watt soldering iron. Electric razors, clippers etc, may or may not operate on the unit, depending on whether they are motor or reed-driven. Vibrating reeds, &c., intended for 50-cycle operation will generally not function with the high input frequency.

Incidentally, for use of the unit other than in a car, attach an earth wire to the set to help eliminate "hash" interference.

LEARN WHILE YOU BUILD IT!

(Continued from Page 29)

not consider the idea of the adjustable detector with this set, as there are already several adustments to be made to get the best results, and it was felt that fiddling with a cat's whisker would be more of a nuisance than ever.

When the wiring has been completed and you are ready to test, the set should be connected to a good aerial and earth, and a sensitive pair of phones.

For a start, set the coils for maximum coupling (the two in line), connect the aerial to the second tap from the earth end, and the crystal detector to middle tapping on the second coil. Rotate the gang, and as soon as a signal is heard, try the effect of varying the coil coupling until a position is found where the strongest signal is obtained without any tendency to a double hump.

Next, try the effect of different aerial and crystal tappings on the respective coils, after which the coupling may again be adjusted.

With all these adjustments at their best, it is time to peak the trimmers, which, up till now, will have been best set at about halfway in. Tune in a station as near to the high frequency end of the band as possible (2SM or 2CH for preference) and adjust each of the trimmers until the signals are heard at their loudest.

If it is necessary to alter any adjustment, particularly the coil coupling, it may be necessary to readjust the trimmers slightly. However, in most cases, it should be possible to leave the various adjustments set, once the best combination has been found for your particular location.

With everything nicely tuned up, we think you will agree that this is the most versatile crystal set we have ever described, the performance of which will take a lot of beating.

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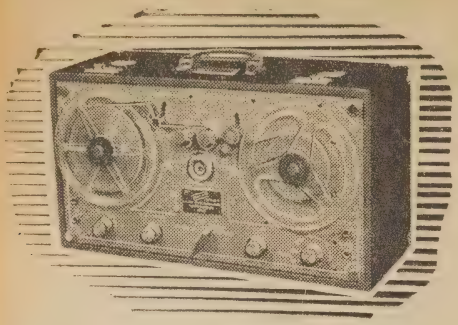

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one cross-over frequency,
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rrection circuit $R_1R_2C_1$,
grid leak; this is made
ay ½-1 Megohm. If the

Amplifier

taken for the formula above are correspondingly 200, 400 and 800 cycles. The values of C, calculated from these values of F, are 0.016, 0.008 and 0.004 μF.

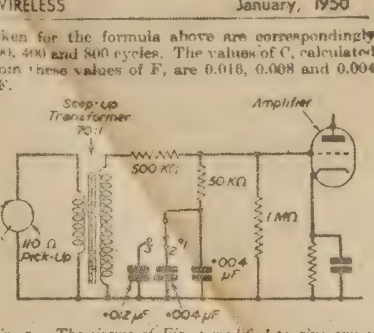


Fig. 5.—The circuit of Fig. 4 modified to give any of three characteristics. Boost is available for cross-over frequencies of 250, 500 or 1,000 cycles/second.

The diagram of Fig. 5 shows how correction for the three cross-over points can be readily obtained

The above circuit diagram is the type of subject which often needs to be copied. This reproduction is from a copy made by the process described in this article.

AVE you ever needed a copy of a circuit diagram, a meter scale, sheet of music, or something of a milar nature, which is too complex trackle by hand?

In cases like this a photographic ipy has a number of advantages. uite apart from the saving of time, ere is the very real advantage that ich a copy will contain no mis-kes, something which cannot al-ays be said for a hand copy. Also, ice the initial work is done, it is ually possible to make any num-r of copies with comparative ease.

But the usual amateur camera is ot suitable for this kind of work. ie box type, of course, cannot focus ider about ten feet, while even the ry expensive types seldom focus oser than three feet.

UPPLEMENTARY LENS

The use of a supplementary lens ill help a little, probably reducing e distance to about 18 inches under vorable conditions. This is not ose enough unless the object to be ipied (i.e., the "copy") is rather rge and the detail fairly bold.

Even assuming that the camera can made to focus to 18 inches and at this is close enough, there re-ains the difficulty of focusing ac-rately at this distance and also at of framing the subject correctly, nce the normal view-finder is now ite useless, due to parralax error. ground glass screen is really re-ired and, of course, this is im-ossible with a roll film camera once has been loaded.

The camera which is really in-nded for the job is a plate camera aving a double extension bellows. his allows the instrument to work ose enough to produce a negative ie same size as the original, and ill cope with all but the most un-sual cases.

XPENSIVE

Such cameras are expensive, and rthermore, are not very suitable r everyday use. This means that ther the convenience of a small roll lm camera must be lost, or that a ecial camera must be kept on hand r copying work. Neither sugges-on is likely to appeal to the mateur.

If such a financial outlay were eing contemplated, it would be far ore logical to invest in a good en-rger, which can also be used as copying camera. We may have ore to say about this method at a later date, but for the present we are more concerned with the needs of the amateur with limited equipment.

The method we are about to describe is by no means new and is used extensively by commercial copying organisations. However, as far as we know, it has not been described in detail before, at least not in this country, nor has any attempt been made to use standard printing emulsions which are readily available to the amateur.

In the case of copy which is printed on one side of the paper only, no great problem exists. If a piece of ordinary printing paper is held in contact with it and the back of the copy exposed to light, the rays will pass through the paper base and affect the photographic emulsion. Where the printed matter occurs, of course, the light will not be able to pass so readily, and so the emulsion will be affected little, or not at all.

Upon development (in the same manner as for prints) we will have a paper negative of the copy; that is, with tone reversed and also reversed left to right. When this is dry we may treat it exactly as any other negative and make a positive print from it. The fact that a paper base is used will sometimes cause a slight loss of definition, but this is of little consequence with the sizes of printed matter normally encountered.

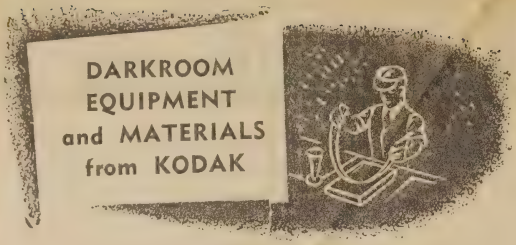
Unfortunately this ideal set of conditions is not encountered very often, and one usually finds that the copy is either printed on both sides, or else the unwanted side is marked in some way which would spoil the duplicate. In this case a more unusual method has to be employed, the copy being placed in contact with the emulsion as before, but the light is shone through the back of the printing paper.

Now this sounds all wrong, and the first reaction to such a suggestion is that we would only succeed in fogging the emulsion, and not obtain any image from the copy because the light does not pass through it.

True, the light passing through the emulsion will cause an overall fog, but if the exposure is carefully adjusted this will be reduced to a faint veil of grey—that is, providing it receives no other exposure. However, where white paper is in contact with the emulsion, the light rays will be reflected on to the emulsion again, and it will be given a second exposure. Where black printing is

by Philip Watson

This month we are describing a rather novel photographic process, which at the same time is extremely useful. It will appeal to the beginner because he can start with simple printing equipment, while the more advanced worker will be able to tackle a class of work which has previously required expensive equipment.



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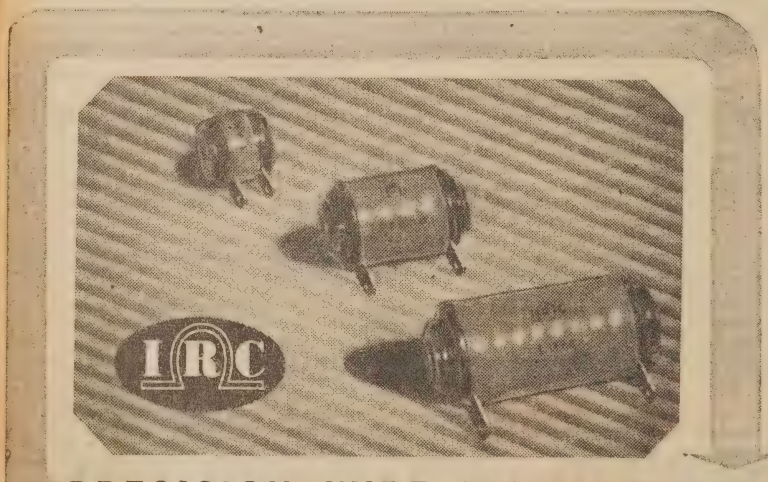

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in contact with the emulsion, very little light will be reflected, and only the faint grey of the original fogging will be apparent. This is what is called a "reflex" exposure.

Thus the printing paper will be exposed according to the image on the copy and, upon development, will produce a paper negative. From this, when dry, we may print off as many copies as required, but using the normal contact process.

In some cases where the copy is thin there may be a faint ghost image of the printing on the unwanted side. This is due to the light passing through the paper and being reflected from the support behind the copy. The trouble may be overcome quite simply by backing the copy with a piece of black paper, the type used to wrap the printing papers being ideal.

LOW CONTRAST

Because the emulsion receives an initial exposure which does not represent the copy image, the contrast of the original reflex negative will be low. Where the original was black and white, the negative will be only two shades of grey. For this reason a high contrast emulsion should be used, and the writer's experiments were conducted with Velox No. 4 printing paper, development being in Kodak Dektol. Any other materials having similar characteristics could be used.

When making the contact print, a similar grade of paper should be used, and it will be found that there will be a considerable improvement in contrast over the negative. While it will not be the pure black and white of the original, it will have quite sufficient contrast for most purposes.

However, if the full contrast of the original is required, as for example when copying a meter scale, this may be obtained providing there is no objection to an extra process. It was mentioned earlier that the contact print showed an improvement in contrast over the reflex negative if a high contrast paper was used. This is the secret behind the second process, for, if we make a new contact negative from the print, the contrast will be still further improved, and will approach the contrast of the original subject.

PRINTING PAPER

If a No. 4 grade of paper is used to make prints from the second negative the resulting contrast will usually be higher than that of the original copy. In many cases this will not matter, but in others there may be a tendency to loss of detail in fine lines, &c., and if so it would be better to use a No. 3 or No. 2 grade, the exact value depending on the subject matter.

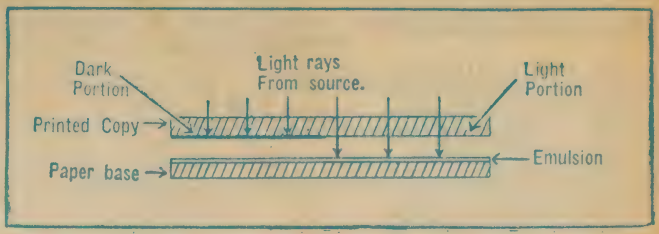
Whether the second process is justified or not will depend on the nature of the job. It is more likely to be worth while if a large number of copies are required, since the extra time required to make the second negative will only be a small proportion of the total. Also, when a second negative is to be made, the first negative and print need not be washed beyond a brief rinse, since they are only a stepping-stone and may be discarded as soon as the second negative is made.

On the other hand, where only one copy is required and merely needs to be legible, the single process offers a distinct saving of time.

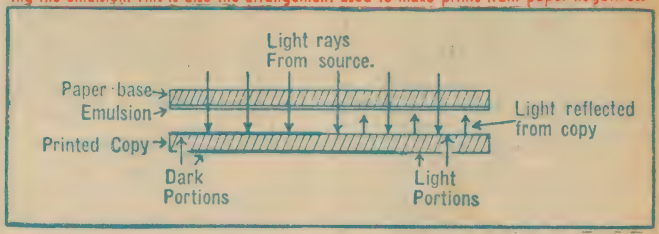
The most important point in this process is to be sure that the emulsion is in perfect contact with the copy, for if this is not so there will be a failure of definition wherever the two are separated. Your initial experiments should be conducted with copy small enough to fit in your printing frame, and a cartoon cut from the daily paper will be as good a subject as any. Load your frame with a piece of printing paper, back to the glass, and then lay your copy face down on top of it. Close the frame and expose to light for the required time.

The actual exposure time will have to be determined by experiment, but, for our own experiments, we gave 20 seconds at two feet from a 75 watt lamp. If you can duplicate these conditions the exposure should be much the same.

Because we have no reduction factor to consider, this exposure will



When the copy is printed on one side only the light passes through it before striking the emulsion. This is also the arrangement used to make prints from paper negatives.



In this diagram is shown the set-up for copy which is printed on both sides. The light rays pass through the emulsion before reaching the copy, and are then reflected from it giving the emulsion a second exposure.

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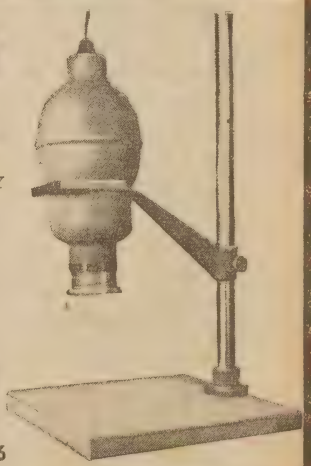

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VT 108	12	90	15	.008	Sync.	21/8
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PF 198	240	285	50	6.3V @ 2A, 5V @ 2A	30/-
PF 151	200,30,40	285	60	6.3V @ 2A, 5V @ 2A	34/-
PF 165	200,30,40	385	60	6.3V @ 2A, 5V @ 2A	34/-
PF 170	200,30,40	285	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	39/10
PF 168	200,30,40	385	80	6.3V @ 2A, 6.3V @ 2A, 5V @ 2A	39/10
PF 130	200,30,40	285	100	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	46/-
PF 160	200,20,40	385	100	6.3CT @ 2.5A, 6.3V @ 2A, 5V @ 2A	46/-
PF 152	200,30,40	285	125	6.3CT @ 3A, 6.3V @ 2A, 5V @ 2A	56/-
PF 181	200,30,40	385	125	6.3CT @ 3A, 6.3V @ 3A, 5V @ 2A	66/-
PF 174	200,30,40	285	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 2A	60/-
PF 175	200,30,40	385	150	6.3CT @ 2A, 6.3V @ 2A, 5V @ 3A	70/-
PF 173	200,30,40	425	175	6.3CT @ 3A, 6.3V @ 2A, 5V @ 3A	110/-
PF 140	200,30,40	385	200	6.3CT @ 3A, 6.3V @ 3A, 5V @ 3A	111/-
PF 171	200,30,40	385	250	6.3CT @ 4A, 6.3 @ 3A, 5V @ 3A	144/-
PF 201	240	225	50	6.3 @ 2A	29/11

LINE TO VOICE COIL TRANSFORMERS

	Pri. Imped.	Sec. Imped.	Watts	Retail
MT111	500	12.5, 8, 2.3	10	36/9
MT100	600	4, 3	15	36/9
MT101	500	15	15	36/9
MT124	600, 500	4, 3, 2.7, 2.3, 2	25	66/-
MT125	600, 500	15, 12.5, 8.4, 6.5	25	66/-

MODULATION TRANSFORMERS

MT118	8000, 6000 PP	10000, 7000 5000	25	85/-
MT119	8000, 6600, 3800 PP	10000, 7500, 6500 5500, 4500, 3500	50	111/-
MT120	500 to 20000 in steps.	500 to 30000 in steps.	50	200/-
MT121	500 to 20000 in steps.	500 to 30000 in steps.	125	276/-

Output Transformer To Voice Coil—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1	5000, 2500 SE	12.5, 8, 2.3	10	39/10
OP54	5000, 2500 SE	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	10	45/8
OP39	5000, 2500 SE	15	10	39/10
OP33	5000, 2500 SE	5, 2.7	10	39/10
OP41	5500 SE	3.7	10	46/-
OP53	30000, 20000 14000, 10000, 7000 5000, 2500 PP	2.2	10	36/9
OP2	5000 PP	12.5, 8, 2.3	15	65/1
OP55	5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP3	6600 PP	12.5, 8, 2.3	15	65/1
OP56	6600 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP4	10000 PP	12.5, 8, 2.3	15	65/1
OP57	10000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	73/10
OP5	10000, 6600, 5000 PP	12.5, 8, 2.3	15	65/1
OP58	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	15	76/2
OP59	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	25	93/8
OP60	10000, 6600, 5000 PP	15, 12.5, 8.4, 6.5, 4, 3, 2.7, 2.3, 2	32	116/8

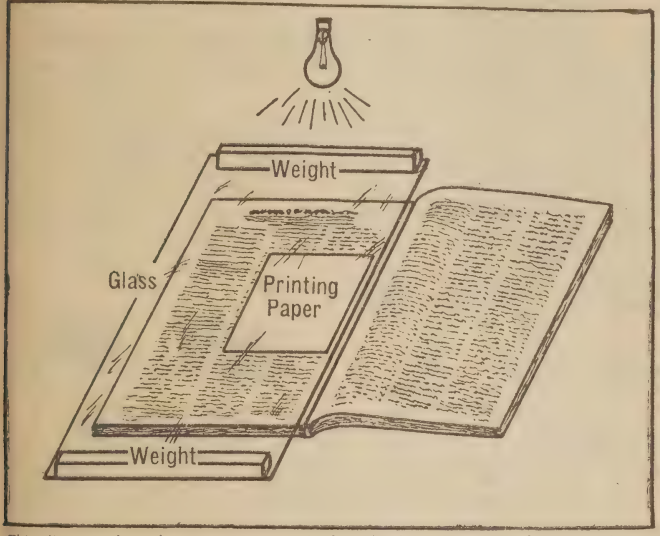
OUTPUT TRANSFORMER TO LINE—P.A. Range

	Pri. Imped.	Sec. Imped.	Watts	Retail
OP1A	5000, 2500 SE	500	10	39/10
OP44	5000, 2500 PP	500, 250, 125	10	47/-
OP34	5000 PP	600, 300, 200, 150, 130, 100 75, 50	15	81/4
OP6	5000 PP	500, 250, 125	15	65/1
OP7	6600 PP	500, 250, 125	15	65/1
OP50	8000 PP	600, 300, 120, 60, 30	15	126/-
OP8	10000 PP	500, 250, 125	15	65/1
OP8M	10000 PP	500, 250, 160, 125, 100, 83.5 71.5, 62.5, 55.5, 50	15	71/3
OP9	10000, 6600, 5000 PP	500, 250, 125	15	65/1
OP10	5000 PP	500, 250, 125	25	81/10
OP11	6600 PP	500, 250, 125	25	81/10
OP38	6600 PP	600, 300, 250, 200, 170, 150, 76, 50, 36, 27, 12.5, 7.5, 3.6, 2.7	25	140/-
OP12	10000 PP	500, 250, 125	25	81/10
OP13	10000, 6600, 5000 PP	500, 250, 125	25	81/10
OP35	10000, 6600 PP	500, 4000, 8.4, 2.2	25	120/-
OP14	5000 PP	500, 250, 125.	32	102/10
OP48	6600 PP	140, 70.	32	117/8
OP15	6600 PP	500, 250, 125	32	102/10
OP15M	6600 PP	500, 250, 166, 125, 100 83.5, 71.5, 62.5, 55.5, 50	32	104/1
OP16	10000 PP	500, 250, 125	32	102/10
OP17	10000, 6600, 5000 PP	500, 250, 125	32	102/10
OP36	3800 PP	17.6	60	108/7
OP18	3800 PP	500, 250, 125	60	108/7
OP61	3800 PP	100, 75, 25, 10, 5, 2	60	133/8
OP37	6400 PP	500, 250, 125	80	150/8
OP49	8800, 6000 PP	500	105	210/-
OP20	11600, 8400 PP	500, 250, 125	150	276/-

ALL PRICES SUBJECT TO ALTERATION WITHOUT NOTICE.

remain the same for all sizes of copy, and because it will produce a negative of standard density, the printing time may also be standardised. Thus if you keep a record of these exposures it should be possible to repeat the process at any time without the need for preliminary experiment.

Quite obviously few types of copy will lend themselves to the printing frame technique, for most subjects occur in books or magazines which are too large to be accommodated in a frame, and, of course, it is seldom that they may be cut. In this case a scheme like that in the accompanying diagram may be used,



This diagram shows how copies are made from books or pages which are too large to fit in a normal frame. More elaborate systems may be worked out when large quantities of work are to be handled.

where the page is held under a sheet of glass suitably weighted to ensure perfect contact with the printing paper.

Since the more weight the better in this regard, a thick piece of glass is to be preferred, while the weights may take on any form which your ingenuity dictates.

The size of copy which you can handle will depend mainly on the size of your developing dishes, and if you can foresee sufficient use for the process, it may be worth while investing in some larger sizes, particularly if you intend to take up enlarging later on. In cases where the size of copy is larger than the available dishes, there is no reason why several negatives cannot be made, each overlapping slightly the area covered by the previous one.

FRAME SIZE

Strictly speaking, the size of the printing frame should also be considered, since this is necessary to make the prints. However, it is usually possible to improvise with the sheet of glass used to make the negative, it only being necessary to hold the negative and printing paper in good contact.

For a start the beginner is advised to stick to simple two-tone subjects, such as line drawings, printed matter, &c., which fortunately is the most usual type of copy encountered.

Half-tone reproductions come under this heading also, since they really only involve the two tones of black and white. However, the printing exposure and choice of paper grade may be a little more critical, as a variation here will effect the size of the dots in the half-tone image, and thus effect the shading of the picture.

The copying of continuous tone subjects, such as photographs, calls for rather more skill, not so much because of limitations in this particular system, but because such copying by any system is bound to result in some distortion of tone at both the shadow and high-light ends of the scale.

This is simply due to the characteristics of the emulsions, and can present quite a problem when a really accurate duplicate is required, it usually being necessary to resort to a certain amount of retouching to secure the desired result. However, there is no reason why the reader should not try it for himself and learn just what can or cannot be done.

BLUEPRINTS

Blueprints are another subject which have their own particular problems. Because most photographic emulsions have maximum sensitivity in the blue end of the spectrum they treat this color much as they do white. Thus it is difficult to obtain an effective contrast between the white lines and blue background.

In the more advanced forms of copying, this can only be done by using panchromatic emulsions in conjunction with a red filter. The red filter holds back the blue rays and causes the film to "see" this part of the subject as black. The white lines are treated as red, and since the film is sensitive to this color, they are

(Continued on Page 89.)

'DUREX' TAPE

TRANSPARENT AS GLASS—SEALS AT A TOUCH WITHOUT MOISTENING

Prevent snags and tears by covering rough curtain rod ends with "DUREX" Tape before inserting in curtain.

Handy Plaid Dispenser with
300 ins. ¾ in. TAPE. 2/6
150 ins. ½ in. TAPE. 1/3
100 ins. ½ in. TAPE. 1/-
PLASTIC HAND DISPENSER only 3/-. Tape extra.
AVAILABLE EVERYWHERE

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Made in Australia by Australian Durex Products Pty. Ltd., Lidcombe, N.S.W.

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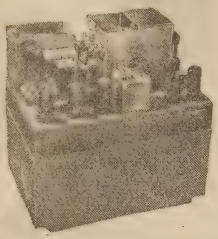
PERISCOPES

(As illustrated)

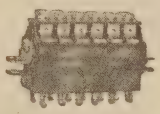
Consists of 2 mirrors, size 4½ x 3¾, with collapsible metal frame. Will extend to 30 inches overall. Ideal for Rear Vision Mirrors or periscopes for any purpose. In canvas case for **7/11** each.



AMERICAN I.F.F. SET

Parts include: Six 6SH7, three 6H6, three 7193 valves and sockets, four relays, carbon pot, genemotor 18 volts input and 450 volts at 60 mA output, a 2 mfd 600 volt working condenser, 1 mfd. 100 volt working condenser, five H.D.W.W. resistors, voltage regulator, ten paper condensers, assorted valves, 36 mica condensers, one 7-plate slit-stator condenser, 60 small carbon W.W. resistors, one 10-pin Jones plug and socket. Many other parts.
Easily worth £60.

Our price £6.

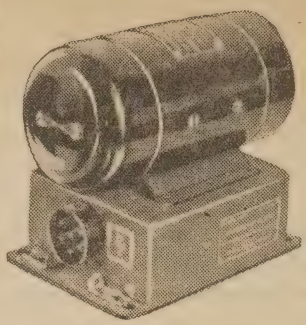


JONES PLUGS and SOCKETS

As illustrated. Available in following sizes, all brand new and perfect.

6 pin 5/6
8 pin 5/6
12 pin 8/6

NOTE: All parcels will be sent registered post, unless otherwise stated. Freight or postage must be included with order.



GENEMOTORS

We have recently procured the following types of genemotors which are ideally suited for operating radio sets, amplifier, &c., off 32 volt lighting plants.

Type No. K.S. 557201.
Input 28 volts DC.
Output 250 volts DC at 60 amps.

Price 35/-.

Type No. D.M. 416.
Input 28 volts DC.
Output 330 volts DC at 170 mA.

Price 45/-.

Type No. P. S. 225.
Input 28 volts DC.
Output 375 volts DC at 150 mA.

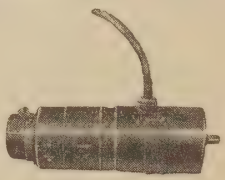
Price 42/6.

Type No. S.5 2669.
Input 18 volts DC.
Output 450 volts DC at 60 mA.

Price 30/-.

Genemotor for S.C.R. 522, input 28 volts; output 300 volts at 260 mA. 150 volts at 10 mA, 14.5 volts at 5 amps.

Price £3/19/6.



REVERSING ELECTRIC MOTORS

(As illustrated)

These motors operate off a 24 volt supply, and are geared down to operate aeroplane cowl gills, &c., have automatic braking device, particularly suitable for beam aerials, &c. They are very powerful, but light in weight.

Price only £4/19/6.

RECORD PLAYER

This record player uses a well-known brand of English Electric Motor, and a good English Magnetic Pickup.
The unit has a 2-pin socket for AC connection and shielded lead for pickup.
It is extremely light in weight and is beautifully finished in Black or Brown Leather Cloth.
Usual price £15/10/-.

Our Price £8/10/-.

DRY METAL RECTIFIERS

1 amp Dry Metal, suitable for making battery charger to charge up to 12 volt battery at 1 amp.
Worth £2.

Our Price 22/6.

2 amp Selenium, suitable for battery charge to charge up to 18 volts at 2 amps.
Worth £3/10/-.

Our Price 39/6.

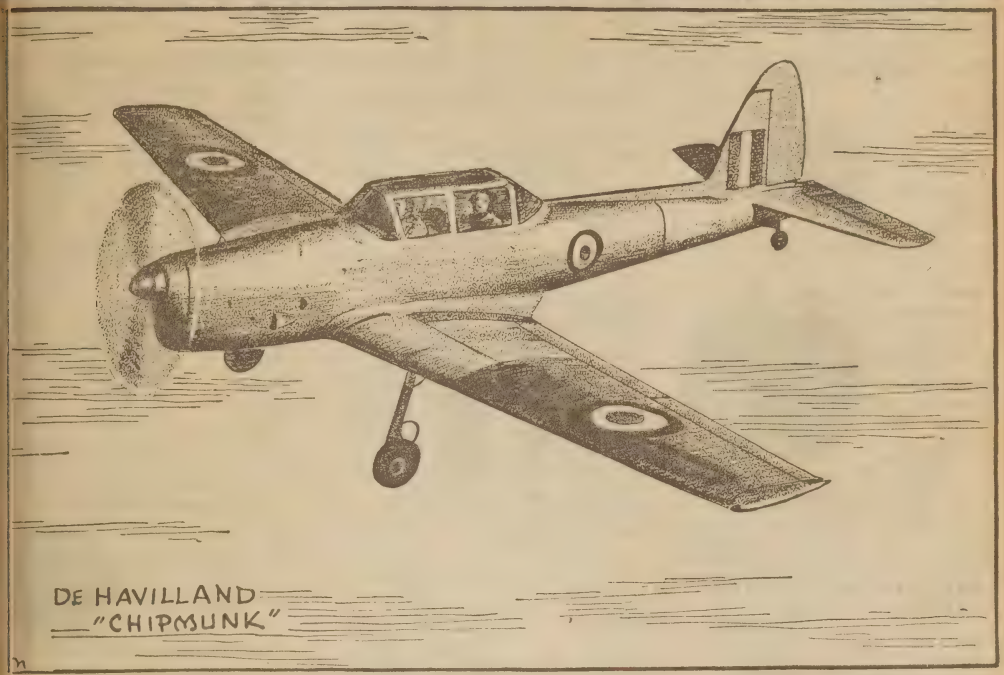
HEADPHONE SET

Dynamic Headphone Sets with lead, in excellent condition. These sets are easily worth £4 per set.
Our special price is only **15/-.**
Transformers to suit headphones. **4/6** each.
Transformers to suit microphones. **4/6** each.

M.S. MOTOR SPARES LTD.

547 ELIZABETH STREET, MELBOURNE

BRITAIN'S NEW BASIC TRAINER



Though the performance of modern service aircraft is continually being stepped up, there is always a demand for more modest types to serve as training planes. One of the latest additions to the ranks is the De Havilland Chipmunk.

A SINGLE-ENGINED two-seat basic trainer, the Chipmunk, is a low-wing cantilever monoplane of all-metal construction. Gross wing area exceeds 170 square feet.

The fuselage is of all-metal semi-monocoque construction in two sections. The tail-fin is integral with the rear fuselage, and the rudder is fitted with a ground-adjustable tab. A Frowden-operated trim-tab is fitted to the starboard elevator only.

Landing-gear is of the fixed cantilever type. The main wheels are carried by rubber-in-compression shock struts. Hydraulic brakes are fitted. The tail wheel is castored.

THE MOTOR

The power plant is a Gipsy Major 8 four-cylinder inverted aircooled engine, without supercharger. This engine drives a fixed-pitch metal airscrew 82in in diameter.

Maximum speed of the Chipmunk is 138 miles an hour at sea-level and 140 miles an hour at 5000ft. Cruising speed is 119 miles an hour at sea-level. Initial rate of climb is 800ft. a minute, and service ceiling is 16,000 feet.

Weight of the aircraft itself is given as 1417lb, and all-up weight is 2000lb. Wing loading is thus 10.6lb to the square foot, and power loading 13.8lb to the horsepower.

Tandem cockpits are provided under a common sliding canopy for pupil and instructor, with all controls and instruments duplicated. Full standard blind-flying panels are fitted.

An interesting feature is the provision of removable and sliding amber screens for synthetic night training. These screens are transparent to the normal eye, but when the pupil puts on blue goggles he is unable to see through the screens, though his instruments are visible to him. The instructor, who does not wear the special goggles, has an uninterrupted view.

The Chipmunk is also fitted with VHF radio and other additional training equipment.

With a range of 300 miles, the aircraft has a stalling speed with 30 deg. flap, of 64 miles an hour. Flight endurance is 2½ hours.

Dimensions of the Chipmunk are: Wingspan 34ft 4in, length 25ft 8in, and height 7ft 1in.

A COURSE IN TELEVISION

(Continued from Page 47).

single deflector. This could only be obtained from a resistance coupled stage operating from an H.T. supply of around about the 800-volt mark.

For a 9in tube, representing about the smallest that can be considered commercially, the deflection voltages are proportioned still higher.

It will be obvious from the above that electrostatic deflection is inconvenient for anything but very small tubes and is, in fact, completely impractical for the larger ones.

The position is only aggravated by the present tendency to make picture tubes as short as possible, for physical convenience, thereby making it necessary to deflect the beam through much sharper angles. There is only one possible answer to this, namely, in the use of magnetic deflection.

The discovery of insulin in 1921 has resulted in a much greater life expectancy for the average diabetic. It is estimated that at the age of 40, a diabetic has a life expectancy more than twice what it was before insulin.

Brand New Head-band type Magnifiers Made in England

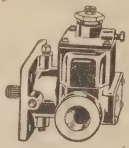
Optically ground Lenses.

47/6

Ideal for instrument makers, watch-makers, tool makers, medical work, chemists, etc.

BRAND NEW AMERICAN PUMPS

USED BY THE R.A.F.

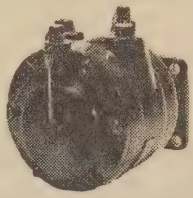


WILL PUMP ANY LIQUID

STAINLESS STEEL VANES

400 gals. per hour 55/-

Brand New American Vacuum or Air Pump

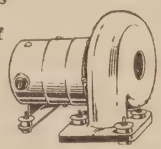


Builds up air pressure to 30lbs. at 1000 R.P.M.

Develops up to 120lbs. per square in. of hydraulic pressure, will pump 7½ gals. S.A.E. oil or other liquids per minute. Useful for spraying, milking, presses, oil burners, hydraulic systems £3/15/-

BRAND NEW ENGLISH BLOWER MOTORS

Work of 12 or 24 volts A.C. or D.C.



Will work off 32 volt Lighting Plants

55/-

FIT ONE TO YOUR CAR. BETTER THAN A FAN.

BRAND NEW CARPENTERS' SAWS

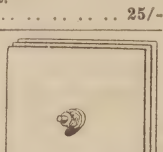
MADE IN ENGLAND.

A real tradesman's job. 4, 4½, 5, 6, 7, 8 and 10 point.

All one price 25/-

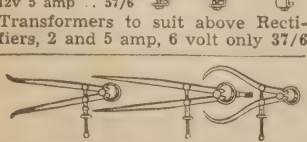
Brand New English Rectifiers

Make yourself a battery Charger.



6v 2 amp .. 24/6
6v 5 amp .. 32/6
12v 5 amp .. 57/6

Transformers to suit above Rectifiers, 2 and 5 amp, 6 volt only 37/6



Engineers' Special Outsize Screw Calipers, 4" Dividers and inside Screw Calipers, each 4/6

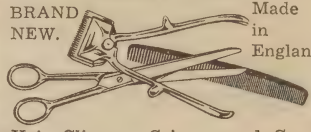
Brand new Vacuum Gauges, 0-30 in Mercury. Each 27/6

Army style expanding wristlet watch bands, chrome plated 9/6

Army Type Bolt Cutters. Ideal for the farm. Many uses 15/-

Why Pay For Haircuts. A complete Barber's Outfit

BRAND NEW.



Made in England

Hair Clippers, Scissors and Comb for 24/6

MOTOR CYCLIST, JUST WHAT YOU HAVE BEEN WAITING FOR

Leather Cloth peak Caps. All colours and sizes. Guaranteed waterproof.

12/9 each.

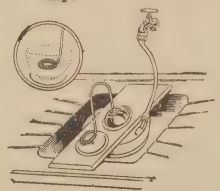
Leather Cloth Trousers.

All sizes and waterproof.

49/6 pair.

Be early for these water driven Cake Mixers. Work off any water tap.

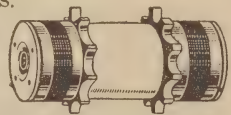
Brand New. Ideal for country users. Will fit any sink. Why pay for an expensive mixer?



Only 39/6

24-volt A.C.-D.C. Geared Electric Motor

100 REVS. PER MINUTE. VERY USEFUL. WORKS OFF



32-VOLT LIGHTING PLANTS.

£2/2/-, cost £6/15/-

BRAND NEW CAR FIRE EXTINGUISHER

Genuine Pyrene. Fit one to your car.

Made in U.S.A. Worth £5/10/- OUR PRICE £3/5/-

Ideal for Trucks or Caravans

Limited Quantity Available.

Genuine English R.A.F. Flying Goggles Mk. 7 .. .. .. 37/6

Flying Goggles Mk. 8 .. .. .. 48/6

Flying Helmets . 32/6

Brand new Speaking Tubes 50/-

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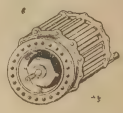
512 ELIZABETH ST., MELBOURNE, C.

PHONE: FJ5904. Just 4 doors fron

RAAF AIRPLANE COMPRESSOR
Two Stages
Limited Numbers
Highest Quality
£5/5/-

R.A.F. AIR PUMPS AS USED IN LINCOLN BOMBERS

Can be used as Low Pressure Compressors or for Low Pressure Spray Guns, Brazing.



Use for Gas Tor

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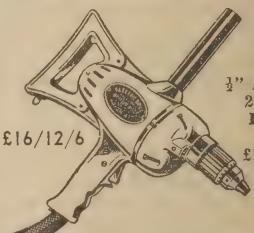
Glass Blowing or Tinning, etc

Brand New American Weston Voltmeters 0-50V, £2/2/-.

0.50 volts, 0.100 amps, combined, £3/10/-

0-10 Weston Ampmeters 50/-



£16/12/6

Britis Ma "Wol ½" AC-D 230 vo Electr Dril £16/12

Never again at this pric Brand new. Limited stocks availab

JUST ARRIVED! ARMY GROUNDSHEET AND CAPE

Ideal for campers, cyclists, hikers.

16

Direct from English Army disposals.

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PLEASE ADD FREIGHT OR POSTAG

Mail Orders Carefully Packe

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SPECIAL OFFER. Black & Decker ¼" Pistol Grip Electric Drills, 230 volts, AC/DC.

£8/19/6

Grinding and Buffing Sets, to suit.

25/-.

AT LAST! British Army Issue
DOUBLE SCALE VOLTMETER
0-15 0-250 VOLTS

IDEAL FOR BATTERY SET USERS AND DEAF AID USERS OR HOBBYISTS.

27/6
Worth £3/15/-

[illegible]IS IS NEWS. GENUINE R.A.F. [illegible]TERPROOF FLYING SUITS
[illegible]ade in England. Brand new.

State Height when ordering

[illegible]al for [illegible]ers, Motor [illegible]e Riders, [illegible]mers, [illegible]ctor [illegible]vers. [illegible]avyweight [illegible]terproof [illegible]terial. [illegible]ed with

[illegible]p Fastener Front, £5/19/6

WATCHMAKERS AND INSTRUMENT MAKERS

English Tweezers 5/6
English Pin Vices 6/6
Single Drivers, 5 sizes, 2/6 to 3/6
Eyeglasses .. .. 6/6 & 8/6
Extra strong double lens eyeglass 15/-

AT LAST!
BRAND NEW AIR COMPRESSOR
2.2 cubic feet, will pump up to 75lb.

Never before at this price.

Ideal for spraying.

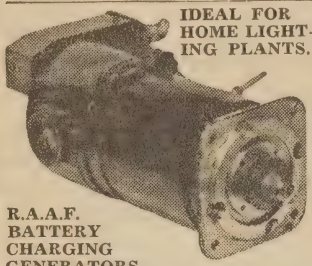
£9/10/-

[illegible]JT [illegible]ARIVED [illegible]AND [illegible]N.V.

[illegible]A Force [illegible]e.
[illegible]e [illegible]ets

All Sizes
Ideal for Motor Cyclists, Motorists, Yachting, etc.

7/6



IDEAL FOR HOME LIGHTING PLANTS.

R.A.A.F. BATTERY CHARGING GENERATORS

24 volt, 1500 watt £13/15/-
Brand New English Lucas, 12 volt or 24 volt £10/15/-

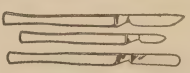
LUCKY PURCHASE BRAND NEW ENGLISH ARMY SPOTLIGHTS

Ideal for Shooting, Fishing, etc.
Fit one to your Car.
29/6

Complete in Case, with Red, Amber, and Green Discs.

'DRILLING OR ENGRAVING

HANDPIECE
[illegible]Bind New .. .. **20/-** each.
Burrs, 2/6 packet of 5.

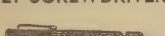


SURGEONS' SCALPELS
6/6 each

Many other uses—Hobbyists, Chiropody, Photography, etc.

[illegible]ade in England Brand New 5-in-1 POCKET SCREWDRIVERS

[illegible]eal for [illegible]gineers, [illegible]echanics, [illegible]bbyists.



5/9

Carry one in your pocket. 5 screwdrivers in one.

[illegible] BRAND NEW [illegible]VESTON DOUBLE READING [illegible]MILLIAMPMETERS
[illegible]C40 O-120, 25/- each

BRAND NEW BRITISH
English 150 amp A.C.-D.C. Meters, 3½" dia. Ideal for generators, 57/6.

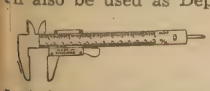
0-1 Milliammeters, 2½" diameter, 32/6.

A Lucky Repurchase, £3/19/6
Brand New Army Phones Ideal for Farms

Install one in your workshop or house. Equal to P.M.G.

[illegible]RAND NEW ENGLISH VERNIER CALIPERS

[illegible]Will measure inside and outside. [illegible]Can also be used as Depth Gauge.

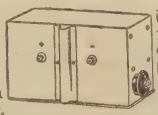


22/6

[illegible]Ideal for all types of engineering [illegible]work. Measures in ins. and m/m. [illegible]Can be carried in the pocket.

AT LAST
Complete Battery Charger

Fitted with brand new English Selinium Rectifier.



Works off 230v. A.C. Household Supply.

Charges any battery from 2 to 6 volts at 5 amps. **£5/15/-** complete.

BRAND NEW ENGLISH BLOW LAMPS. Works from kerosene.

½ pint size .. **37/6**
1 pint size .. **45/-**
2 pint size .. **52/6**

THIS MONTH'S BARGAIN LIST

English Diagonal Cutting Pliers, **6/6**
Extra Long Nose Radio Pliers, 8" long, pair **9/6**
American Feeler Gauges **8/6**
Dental Inspection Mirrors **5/6**
Pressure Gauges, 0-200lbs. .. **27/6**
Brand New Army Boots, Size 9 only. Pair **26/9**
English Spiral Screwdrivers .. **16/6**
Rear Vision Mirrors, Chrome **19/6**
Car Tow Ropes, 13ft. long .. **9/6**
Gasket or Workshop Snips **4/9**
English Barbers' Scissors, pr. **12/6**
Brand New Micro Switches **8/6**
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Chrome plated 2 cell torches, complete with batteries **9/11**

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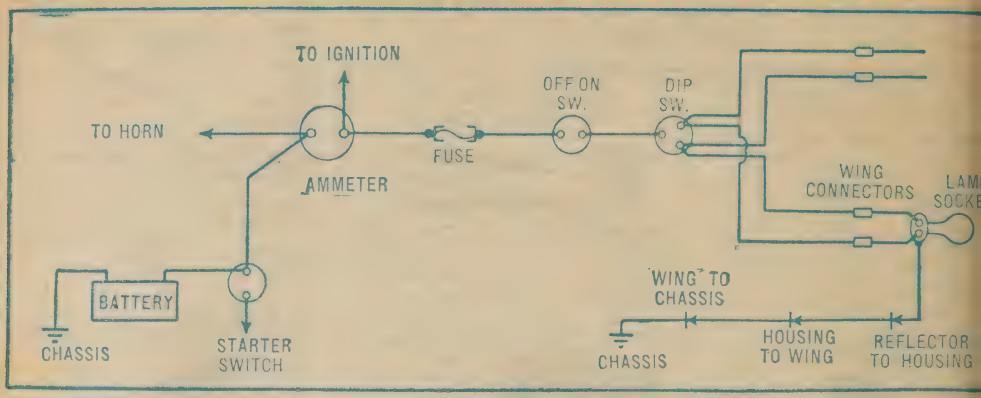
INCLUDE STATE IN ADDRESS

and Efficiently Despatched

KEEP YOUR CAR HEADLIGHTS BRIGHT



Ths diagram of a typical lighting system illustrates points made in the article.

Recent tests in Sydney proved that a very large proportion of cars on the road have faulty headlamps. A good deal of the trouble is electrical in character and can be traced out by any handyman who has access to a voltmeter. Read this article—it may easily save you from an accident.

HEADLIGHTS seldom fail outright. On the contrary, they tend to lose brilliance very gradually and it may be months before the driver becomes aware that something is really wrong with the system. In the meantime, night driving has become gradually more dangerous, both for himself and other road users.

However, lights can be put to several simple tests. Walk round the front of your car, or watch the reflection of its lights in shop windows. If they look yellow, it's an even bet that near to half the available voltage is being lost before it gets to the lamps.

And again, if your car throws a shadow on the road from the car lights behind, it is a good indication that the other car is lighting the road better than you are, and there's no real reason why it should.

Can you see to drive properly on a wet bitumen road, which soaks up the light like no other surface? If the answer is no, you are courting disaster.

MECHANICAL TROUBLE

Some of the trouble may, of course, be of mechanical origin. The reflectors and globes may need focusing in an older car and, where this is so, it is unusual to find focusing instructions in the manual for the particular model. More recent models have fixed-focus lamps but the housing may have shifted and caused the beam to shine anywhere but the right place.

Watch the lamp bezel, too. This n't just a piece of glass to protect e "innards" most bezels follow a finit al pattern, many types being intended to produce a narrow rectangular beam which illuminates the road but remains substantially below eye level.

An unsuitable replacement bezel may entirely alter the lighting. In a case of doubt, it is wise to seek expert advice but where this is not forthcoming, it is not difficult to pick out and correct obvious faults.

Drive the car onto a straight, quiet street and bring it to a halt in more or less the normal driving position on the road. Then throw a bag over each of the headlights in turn and note the direction and focus of its opposite number.

You can check the direction of your car in relation to the street by sighting from behind the car, through the exact centre of the rear window and over the mascot on the front of the bonnet.

BEAM HEIGHT

On the top beam, the light should slope gradually downward, lighting the road surface to about fifty yards ahead of the car. If the beam is too high, it will not light the road surface properly and will dazzle an oncoming driver. Remember, too, that the beam may lift perceptibly if there are passengers in the rear seat.

Loosen and set the lamp housings so that the beams just merge in the centre of the road, while shedding sufficient light on the edges, particularly on your own side where pedestrians and cyclists are likely to loom up.

On the "dip" beam, the light should now light the road brilliantly about three car lengths ahead, with plenty of illumination on the pa ment edge and on the centre l of the road. If not satisfactory, so compromise may be necessary to the best results with the respect beams.

In practice, most of the use light from a headlamp is thro forward by the reflector and t must have a high polish to be fective. Treatment with plate po der and a soft cloth will work wo ders in many cases, but where surface has deteriorated, re-plati is the only answer.

Then make sure that the glo are of the type recommended for particular car, especially if th are of the fixed-focus type. Furth more, if they have been in serv for a long time, fit new globes, the old ones may have lost a g deal of their brilliance, either deterioration of the filament or gradual clouding of the glass.

The globes must be at least candlepower (18 watts), the m usual size being 30cp.

SEALED BEAMS

When it is obvious that money h to be spent on both globes and r flectors, many motorists have ado ed the course of fitting new seale beam units into the old housings. variety of hardware for the purp is available through motor access dealers.

Check the details carefully, ho ever, before going too far, becau unsuitable adaptions can be lit short of hideous. What is more i portant, sealed-beam headlamps w not solve the problem of low oper ting voltage, which is the greate single enemy of good lighting.

he electrical connection between
ar battery and each headlamp is
er a direct one. In practice, the
uit is interrupted by the off-on
tch, the dip switch, the fuse and
ler, the ammeter and by the vari-
of connections between them.
er a few years of service, the con-
ting lugs are likely to become
oded or dirty and introduce re-
ance into the circuit. This lowers
effective voltage agross the globe.

xpressed mathematically, the
age drop across any resistance is
al to the product of the resist-
e in ohms multiplied by the cur-
t in amps.

hus, a pair of headlamps drawing
10 amps will lose 1 volt if there
is little as one-tenth of an ohm
the wiring circuit. In practice,
resistance can be many times this
ire.

VOLT SYSTEMS

ars having a 12-volt lighting sys-
are in a fundamentally better
ition than those with a 6-volt
tem. In the case just quoted, a
istance of one-tenth ohm was
wn to cause a loss of one volt,
resenting a reduction of 16 per
t in the effective voltage.

n a 12-volt system, headlamps of
same wattage would draw only
mps, causing one-half volt drop
oss one-tenth of an ohm. The
centage of reduction would there-
e be ½ in 12, or just over four per
t, which is a very different
ire.

An accurate voltmeter is invalu-
e in tracing out voltage drop in
lighting circuit. If you have
voltmeter, and cannot borrow one,
u may still be able to effect a
ge improvement by simply check-
on the points to be mentioned.
By way of example, the writer
cked two cars recently of quite
ferent make, but showing almost
ntical faults in the wiring sys-
n. What was true of these cars
l also apply to most others.

n both cases, the battery had been
pped up" and checked for
arge. It is obviously futile to
empt accurate voltage readings
th a run-down battery because
line voltage will be dropping the
ole time the lights are on.

ROCEDURE

Begin by checking the voltmeter
edle carefully to see that it reads
actly zero on the scale and with
e meter in its normal reading posi-
n—either vertical or horizontal, as
e case may be.

It should always be used in this
sition and the needle should al-
ys come back to zero after each
flection. You cannot make ac-
rate readings with a "sticky"
ter.

Take a reading off the battery volt-
e without load. It will normally
ad about six volts, depending on
e exact condition of charge, &c.
hen switch on the lights and note
ether the reading drops. You
n expect it to drop to about 5.9
lts with the lamps glowing.

Remove the voltmeter leads,
itch off the lights and go round
the front of the car. Take off one or both of the bezels and, with the aid of appropriate clips or scraps of wire—the details will vary in each case—connect one lead of the voltmeter to the active lead where it passes into the headlamp socket In some cases it may be necessary to push a fine needle through the insulation to establish a contact with the incoming wire.

The other lead from the meter should be connected to the reflector, assuming that this is still making contact with the lamp housing.

Now switch the lights on and take a voltage reading. If the meter reads backwards, it simply means that the leads must be reversed. But you may be in for a surprise. Of the two cars mentioned, one showed a lamp voltage of 4.1, the other was 3.7—and in neither case were the lights as dull as many we've seen on the road!

On the other hand, if you get a reading up around the 5.5 volt mark, you can put the voltmeter away and forget it. The inevitable voltage drop in an ageing six-volt system is not likely to be less than about .4 or .5 of a volt.

Although the method of wiring differs from one car to the next, the sequence of connections is generally more or less standard and it should not be too difficult to pick out the strategic point in the circuit, even without the aid of an electrical wiring dagram.

One binding post of the battery, usually the positive side, is connected directly to the chassis or engine block through a heavy stranded cable. The other binding post is usually taken through a very heavy insulated cable to one side of the starter switch or solenoid, the other side connecting to the self starter.

METER CONNECTIONS

The supply wire for the rest of the electrical system is normally taken from the active side of the starter switch straight up to the ammeter on the dash. In most cases the ammeter will have two terminals for the electrical connections but there are types in use where the wire carrying the current merely passes behind the ammeter frame without actually being interrupted.

Still another common arrangement is to replace the ammeter with a relay and light combination to show when the generator is or is not charging.

Whatever the system, it is almost certain that the lead coming from the battery via the starter switch will be terminated by a lug on a binding post somewhere near the ammeter or its equivalent device. This serves as the distribution point for the system.

The lead to the horn normally comes off this point, since the current is too high to take through the ammeter circuit.

However, the circuit for the lights, the ignition and other auxiliaries, together with the return circuit from the generator, passes through the ammeter.

Some variation in method may be evident at this point but the lighting circuit will inevitably pass through a fuse and thence to the "off-on" and "dip" switches.

At the last of these switches it is likely that leads will divide, one set of leads (for high, dip and parking) running to each headlamp.

Where the headlamps are mounted in the wings, it is usual to provide for some form of clip or a plug-and-socket, which allows the wings to be detached without cutting wires. Finally, there is the lead into the lamp housing itself and the spring connection to the rear of the globe.

The return circuit via the frame of the car, involves the metal-to-metal contact between the reflector assembly and the lamp housing, the contact between the housing and the fender and the contact of the fender with the frame.

USE OF METER

Every one of these connections must be open to suspicion in a car which has been on the road for a few years. It is commonplace to check them over one by one and to find a drop of .2 volt here, 1 volt somewhere else, and so on, the total drop often amounting to best part of 2.0 volts.

The progressive loss can be picked easily with the aid of a voltmeter. At the battery, the variation in voltage with the lights off and on may be only from 6.0 to 5.9 or thereabouts. At the ammeter, the reading may vary from 6.0 to 5.5, being lower still at the active terminal of the light switch.

Normally, there is only one way to rectify the trouble and that is to take off a Saturday afternoon, put on some old clothes and get to work. Remove the wires from each binding post, in turn, clean the lugs with fine emery cloth, see that the solder is intact, and then replace the lugs on the binding post, screwing the nut as tight as it will go.

Oil, grease and rubbery "goo" which are likely to collect around junction points can be removed best with a paint brush and a small tin of petrol.

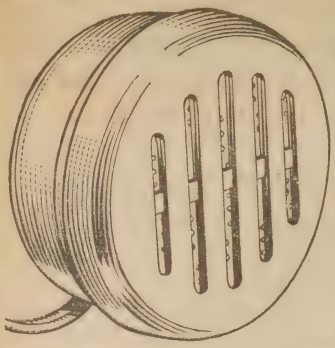
Assuming that the battery is in good order, clean the binding posts with fine emery, clean the inside of the clips and make sure that they will grip the posts firmly when the nut is tightened up. It is wise, however, to leave the active lead off while you are tinkering with the wiring to avoid risk of a short circuit.

CLEAN CONNECTIONS

Trace the active lead through to the starter switch and the take-off point to the ammeter and auxiliary circuits. Remove the locking nut, clean the connecting lugs and then clamp them all tightly in place again. Do the same for the lugs which attach to the rear of the ammeter or the equivalent binding posts, taking care not to get the leads confused.

A weak spot in many systems is the junction between the remote side of the ammeter and the fuse. The junction is often effected by a brass strap which is really part of

(Continued on Page 94)



PILLO-FONE

Extension Unit

IT'S A REAL MINIATURE ROLA UNIT. 3½" x 1¾" DEEP

Install it anywhere, in the sickroom, workshop, garage or any room in the house. Just connect across voice coil of the existing speaker.

The "Pillo-Fone" is the most convenient little unit yet devised.

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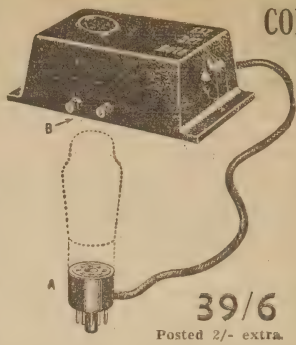
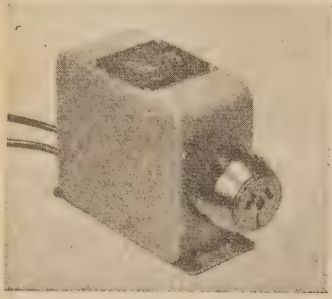


CONTROL UNIT

With three-position switch, for operating Set and Extension, or both. It's the ideal unit for Extension Speakers . . . no technical knowledge needed . . . no wiring required . . . operation is simplicity itself. Remove output tube from receiver and insert adaptor (A), replacing output valve in the top of the adaptor. Connect the leads from the Extension Speaker to the terminals.

39/6

Posted 2/- extra.



—INVERTERS—

Input voltage, 6V, 12V, 24V, or 32V, D.C. output 240V, A.C. at 30 watts, 100 cycle. These units are suitable for the operation of any standard 4 valve A.C. receiver from your car battery, home lighting plant or any D.C. supply.

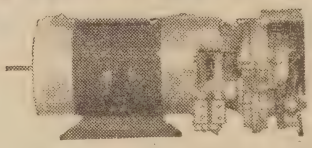
£8/15/-

A RANGE OF INVERTERS WILL SHORTLY BE AVAILABLE POST FREE WITH OUTPUT OF UP TO 150 WATTS AT 50 CYCLE. 240v A.C.

THE MOTOR WITH 1000 USES FOR THE HANDY MAN

I.F.F. MOTORS

rated at 18 Volts DC.
Develops 1/10 H.P.
Operates on as low as 6V.
Converts easily to 240 AC as per R & H December, '49, or Hobbies Illustrated Nov., '50.



Postage and Packing NSW 7/6 Interstate 9/6

Revs. at 4200.
Fitted with Gear Box
Extended ¼" Shafts giving speeds of 4200, 150, 25, 4 R.P.M. Use a Rheostat and have Variable Speed.

£2

AMERICAN—I.F.F.—UNITS—TYPE—966

I.F.F. units each containing, genemotor as advertised above, voltage regulator, H.F. oscillator units with three 7193 valves easily converted to the 144 m/c band, one 6SH7 valve, coax plugs and sockets and about fifty various condensers and resistors.

£3/15/-

Freight Extra

—MINIATURE RELAYS—

New American miniature relays, suitable for your transmitter, model aircraft, etc . . S.P.D.T. . contacts, 300 ohm coil suitable for rewinding. Overall measurements, 1¼" high, 1⅛" wide, ¾" deep. Weight, ¾oz.

10/-

Post Free

METROPOLITAN RADIO SUPPLIES

479 PARRAMATTA RD., LEICHHARDT. PHONE LM3610

AT TOP OF TAVERNER'S HILL

SHORT WAVE NOTES BY RAY SIMPSON

On two occasions during the past month we have heard cricket broadcasts from the West Indies. The best heard of these was from VP03 in Bridgetown, Barbados operating on 10.605mc and was logged at 5.30 am Sydney time. Although reception was quite good it was difficult to follow as to who the opposing sides really were.

E commentator seemed to confide his description to the individual scores of batsmen which of course would possibly be the main interest of the local listeners. We did notice in the local broadcast where two West Indian batsmen added over 2000 runs each.

The second broadcast was heard on the following week-end, and we think this time it was the Kingston Jamaica station ZQ5, as it was heard on about 12.05 mc, which is the frequency allotted to that station. Reception this time was only poor to beyond the fact that it was a cricket broadcast, no details could be obtained.

During the next few weeks we would like listeners to keep a check on VPO3 and VRR5 and also the British Guiana station in Georgetown which was heard a couple of years ago over ZFY on 11.75 mc. There is also the other Jamaican station VRR4 on 11.595 mc, which is also quite likely to be used for some of these sporting broadcasts. All the above stations verify so it is well worth writing to them.

"HE PEOPLE'S STATION"

Many Australian and New Zealand listeners have sent reports to The Peoples' Station, DUH2, but we have never heard of anyone receiving a reply. It was therefore very interesting to know from A. Cushen that he has at last been rewarded for his patience in the receipt of a letter of verification from the station.

The letter was from the office of the President of the Philippine Republic and was signed by Mr. Francisco Trinidad, managing director of DZFM and DUH2. In his letter, Mr. Trinidad said they had been able to verify sooner owing to pressure of other work so let us hope it will be the forerunner of verifications to other listeners.

STATION ADDRESSES

CA8 Radio Real de San Carlos,
Flores 30, Colonia, Uruguay.
CX4Q Radio Victoria,
Edificio Mineria No 508-510, Lima, Peru.
HIAC La Vez de la Democracia, Calle Leon 780,
Apartado 288, Oriente, Quito, Equador.
HJDE La Voz de Antioquia Cia Colombiana de Radiodifusora, Maracaibo 46—48, Medellin, Colombia.
HP5A Cadena Panamena de Radiodifusion, Apartado 954, Panama City, Panama.
COBZ Radio Salas,
San Rafael 108, Apartado 866, Havana, Cuba.
YDM Radio Indonesia,
Studio Fort de Kock, Fort de Kock, Indonesia.
YDG Radio Indonesia, Studio Solo,
Djalan Marconi, Solo, Ondonesia.
CSB51 Radio Club Portugues,
Parede, Portugal.
OXI Radio Station OXI,
Godthaab, Greenland.

SOME NEW STATIONS

INDIA: India must now be reaching a record number of frequencies and call letters as we again have to chronicle some more outlets for the Delhi transmitters of All India Radio. They are now transmitting to Europe on 7.155 mc and 9.72 mc with news in English at 5.0 am and sign off at 6.0 am. News in English can also be heard at 6.0 pm on 17.74 mc, while there is another programme on 9.72 mc directed to the West Indies broadcast between 9.30 am and 10.30 am. At one time we were able to keep a check on the suffix figures after the VUD call letters, but of late with so many changes of frequencies and lack of information from the stations it has become impossible to refer to them except as another VUD.

SPAIN: A real surprise was to find the well-known Radio Nacional de Espana in Madrid moved from its long used channel of 9.369 mc. They are now right in the 31 metre band and using a frequency of 9.585 mc. In the mornings at 6.30 when their English programme is in progress they are heard at great strength and give their frequency around 6.45 am. They then continue with the regular news in Spanish until leaving the air at 7.0 am. For years now this station has been like an orphan outside the band, but now is still another to crowd this already congested band. They seem to be interested in reports and regularly send us their attractive little programme booklet which is written in both Spanish and English.

NEW STATION LOGGINGS

Call	KC	Metres	Location	Time Heard
Reunion	4810	62.37	St. Denis, Reunion Is.	4.30 am
Paris	5970	50.25	Paris, France.	6.30 am
Khartoum	5970	50.25	Khartoum, Sudan.	5.00 am
ELBJ	6025	49.79	Monrovia, Liberia.	9.00 am
FZP8	6040	49.67	Papeete, Tahiti.	2.30 pm
FZP8	6135	48.90	Papeete, Tahiti.	2.30 pm
Honolulu	6160	48.70	Honolulu, Hawaii.	5.30 pm
Nepal	7100	42.25	Nepal	12.30 am
VUD	7155	41.94	New Delhi, India.	5.30 am
Budapest	7220	41.55	Budapest, Hungary.	7.00 am
CR6RO	7582	39.51	Silva Porto, Angola.	5.30 am
Madrid	9585	31.30	Madrid, Spain.	6.30 am
VUD	9720	30.86	New Delhi, India.	5.30 am
CR6RJ	9755	30.76	Huila, Angola.	4.30 am
S.A.B.C.	11930	25.15	Johannesburg, South Africa.	5.30 am
TIHH	11960	25.08	San Jose, Costa Rica.	11.00 pm
S.A.B.C.	15230	19.70	Johannesburg, South Africa.	1.30 am
VUD	17740	16.91	New Delhi, India.	6.00 pm
Rome	17740	16.91	Rome, Italy	6.15 pm
S.A.B.C.	17750	16.90	Johannesburg, South Africa.	1.30 am

FLASHES FROM EVERYWHERE

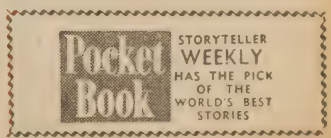
LIBERIA: Here is a country which few listeners will have heard and it is therefore interesting to learn through Radio Australia that the Liberian Broadcasting Company's station, ELB2, on 6.025 mc, has been heard in the USA around 9 am. The programs heard have been transcribed versions of the Voice of America broadcasts, though on one occasion there was a request session with birthday greetings from 9.15 am till 9.45 am. The station appears to leave the air just before 10 am. During the abovementioned request program, Dr. John B. West asked listeners to write to the station, the address given being Liberian Broadcasting Co., Monrovia, Liberia, Africa.

NEW ZEALAND: Australian listeners have become very interested in the excellent programs provided by Radio New Zealand, and we know they will therefore be interested to know of the new schedule which comes into effect as from March 10. As from that day, transmission times will be as follow:—To Australia: 4 am to 6.45 am, ZL8, 9.62 mc; 7 am to 4.45 pm, ZL10, 15.22 mc; 5 pm to close, ZL8, 9.62 mc. To Pacific Islands: 4 am to 6.45 am, ZL3, 11.78 mc; 7 am to 4.45 pm, ZL4, 15.28 mc; 5 pm to close, ZL3, 11.78 mc. Closing times are: Weekdays 8.30 pm, Saturdays 9.20 pm, and Sundays 8 pm. We should imagine that ZL8 will give a very good signal, as last time they used this transmitter it was logged at excellent strength.

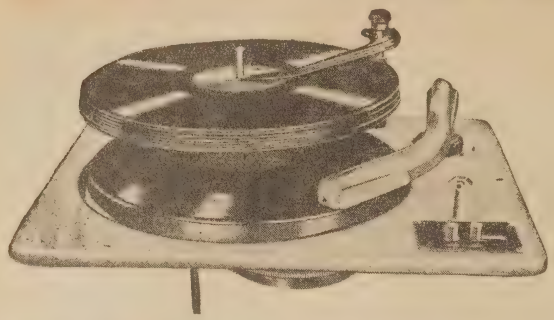
SOUTH AFRICA: Experimental transmissions are now taking place from South Africa by the SABC, and the station is very anxious to have reports from any listeners in Australia who may hear them. These programs are actually intended for listeners in Central Africa and the schedule is as follows:—Afrikaans (or "B") programs are on Sundays, Mondays, Wednesdays and Fridays; while English (or "A") programs are on Tuesdays, Thursdays and Saturdays. Monday to Friday 0830-1200 GMT and 1400-2005 GMT; Saturday and Sunday 0830-2015 GMT. Frequencies being used are 0830-1200, 1400-1545 GMT on 17.75 mc or 15.23 mc; 1600-2005 GMT on 11.93 mc or 9.87 mc. We suggest you try the 11.93 mc channel around 1900 GMT.

NEPAL: Here is another new country for the keen DX fan and although we have not positively identified the station at our own location we are practically certain it is this country we have been hearing around midnight. The Nepal Radio was first reported to be operating on 7.0 mc, but latest information from the DX session over Radio Australia gives the frequency as 7.1 mc. They have three sessions, all of which open with an announcement in English. The first one is from 2 pm to 2.30 pm, the second from 6.30 pm to 7.30 pm, and the last one from 12.15 am till 1.15 am. This station is also reported to be using 60 mc, but, of course, this channel would be inaudible in Australia.

SUDAN: Our old friends the Omdurinan broadcasting station, in the Sudan, is now using a new frequency, 5.97 mc. Their schedule is reported to be 2.15 pm to 2.45 pm daily, 2.30 am to 4 am, and 5 am to 5.30 am (except Friday). On Friday they are on the air from 6 pm to 7.30 pm, and on Saturday from midnight (Friday) till 1 am, 2.30 am to 4.30 am, and 5 am till 5.30 am, all programs being in Arabic. English can be heard on Saturday only from 3.30 am till 4 am. The same program can also be heard in the 31 metre band on 9.745 mc, but the lower frequency channel can also be heard at quite good level on most mornings.



two of the best . . .



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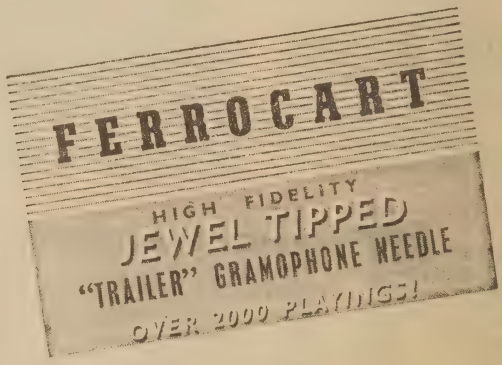

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EI/2658

HE HAM BANDS WITH BILL MOORE

mateur Radio in the last couple of years has received more publicity in the Press and irough other mediums than ever before. The movement has become far better known to the general public.

must be appreciated that when any vement makes the news, all publicity ved will not be pleasant, as was the htfully vague story in the daily Press w the bombing of Korea was delayed a radio amateur in Japan talked to girl-friend in the US.

ile adverse publicity in itself is not acceptable, another problem that has n, created, probably unwittingly, by eurs themselves, is causing some con-

cently, amateurs individually have pushing the cause to the public, als, politicians, &c. While general icity broadcast in this manner must f value, any tendency to propose rete variations of regulations or mode peration should be deplored.

ch proposals may be the considered ion of the individual or his immediate iates, but may not be a true reflec- of amateur opinion in the Common- th. They may even cut across nego- ons being conducted by the Wireless tute of Australia.

EXAMPLE

an example we quote a recent hap- ng in Great Britain. A group of ama- s arranged with their local member uestion a decision of the Postmaster- eral on the refusal to allow radio eurs to co-operate in listening for ess calls from ships. The whole lect was aired in Parliament.

e RSGB's comment ran as follows: is singularly unfortunate that, at a when the Society is in touch with Ministry of Transport and the Post e on the general question of assist- by radio amateurs on occasions of rgency at sea, a small body of ama- s should take independent action and prejudice the outcome of negotia- which, based on much stronger evi- e and with much wider support, d have produced far greater effect."

Similar cases will happen here unless viduals appreciate the damage that be done if negotiations are not con- ed in a logical manner.

ere is only one way to obtain any- g like a true cross-section of amateur inion, and that is through the normal tioning of the WIA.

proposal, for instance, is fostered by ndividual amateur in a particular State. then discussed and voted upon by nteurs in that State. If the majority oting members are in favor, the pro- al can then be placed before Federal ncil, or possibly become an agenda m for a Federal convention. The item en voted upon by all State Divisions, n when the majority of Divisions are in r, the Federal Council vote it as WIA cy.

can be seen that any proposal, to be ved, has first to be agreed upon by n majority of the voting members of a sion, and, secondly, by the majority he Divisions. If you have some pet on the future of the hobby, pass it g through the logical channels, and will soon see if it meets with general roval. It will lead to less confusion, allow the movement to speak with one ce.

W ZEALAND WAP

AP (Worked All Pacific) awards issued the NZART have nearly reached the ty mark.

o qualify one has to produce 30 QSL's m the Pacific area. Seven ZL's and VK stations have to date qualified the award. They are: ZL1HY, 2GX, 4GA, 2QM, 2FA, 3BJ and VK2DI, 7LZ, 3BZ, 2QL, 2NS, 3JE, 2HZ.

ck White, ZL2GX Contest and awards the NZART of Patutahi, Gisborne, uld be pleased to receive applications n the necessary confirmations. Suffi- cient postage for return of the certificate should be included.

The certificate is an attractive one. Full lists of Pacific countries have appeared in Amateur Radio from time to time.

The number of radio amateurs in the US reached an all-time high of 90,000 in 1951, an increase of 6000 for the year. It is anticipated that the total will reach 100,000 this year if the Novice Licence class under the proposed new regulations becomes a reality.

Still no final news of Docket 9295 covering the changes. Color Television and other problems have kept the FCC too busy to concentrate on amateur affairs.

The Voice of America broadcasts on amateur affairs sponsored by the ARRL have been extended, and a service is now beamed to Central and South America, as well as the old services to Europe and the Far East.

The new service is broadcast at 1144 hours EAST Sundays on frequencies from 6.08 through 21.51 mc/s. This is a far more convenient time than at 0045 hours EAST and 0515 hours EAST Mondays, when the other services are broadcast.

The session has been received at quite good strength at midday Sundays on 15 mc/s.

EXPERIMENTAL VALUE

The British National Society, the RSGB, recently has been stressing the experimental value of the hobby. As was the case here in Australia, the designation was changed postwar from experimental to amateur radio station in Great Britain, a change they now apparently regret.

The society explains that much of the work on the UHFs is purely experimental, and it is felt that the British amateur can do valuable work in this portion of the spectrum.

With this point in view, the RSGB have applied to the Post Office for permission to conduct experimental Television transmissions on the 420-460 mc band. The Postmaster-General has agreed that a station be set up in this band, and check whether Television transmissions can be carried out without interference to other services.

The serial number business in DX contests is still a little confusing, as, generally speaking, no effort has been made to standardise it. Some years ago the WIA adopted for their DX contest the serial number of the W/VE DX contest. Since that time the ARRL has varied its number system, the final three figures of the serial number indicating the power input on the particular band in use.

While it is appreciated that American stations have the greatest respect for our low power activity here in Australia, some of them were rather astonished to hear what a one-watt signal sounded like. At least that was the impression they gathered, as stations here were still using the old numbering system starting from signal report and 001; indicating under the present system one-watt input!

NSW ACTIVITY

One hundred and twenty members attended the February meeting of the NSW Division, when Professor V. A. Bailey, MA, D.Phil (Oxon), F.Inst.P., Professor of Experimental Physics at Sydney University, lectured on "Gyro Interaction," disturbance of the Ionosphere by means of radio transmissions.

The professor has during the past year conducted a number of experiments in which radio amateurs co-operated by reporting on the special transmissions. The professor explained that it was possible to interfere with the ionosphere with a radio transmission so that it would modulate another transmission.

This was demonstrated when pulse transmissions from the New England University College modulated 4QG National station's signals. He also pointed out that with sufficient power, it would be possible to light up the ionosphere by causing an artificial aurora. The lecture was very instructive and greatly appreciated by all present.

John Moyle, VK2JU, was elected Federal Councillor for the Division for 1950 and '51, and represented NSW at the 21st Federal Convention held in Melbourne during Easter.

Frank Nolan, VK4FN, Queensland WIA stalwart and operator of VK4WI over the past four years, has been forced to relinquish the position for health reasons. Frank worked at a fast pace to make the VK4 broadcasts the most complete of any State. Amateurs throughout Australia wish him a speedy recovery.

At the March meeting of the Hunter branch of the WIA, Dave Davies, VK2BZ, and Jack Hill, VK2ADT, entertained the members with the story of their UHF activities. It was good propaganda for the UHF gang, and although activity on this portion of the spectrum is at a high level in Newcastle, some more converts were gained.

Fred Meyer, VK2AGY, was in the chair, and from all reports the branch's team in the National Field Day scored particularly well.

DX AND PERSONAL

CONTESTS during January, February and March were well to the fore. The first was the WIA's National Field Day run over Australia Day weekend, and it was extremely pleasing to see it so well supported.

It is really the first occasion during which the contest has received anything like the support it deserves. The final results will appear in "Amateur Radio" and some good scores were amassed.

The next seven weekends were just a jumble of the BERU and ARRL DX contests. It is about time that these contests were run over fixed periods with some interval between them. Both societies, the ARRL and RSGB, have changed the dates in recent years, and on this occasion really managed to sandwich them up.

Power cuts restricted operation in NSW during both contests.

It is doubtful whether any amateur has ever put so much work into any single event as did Crieff Rettalick, VK2XO, North Coast Zone officer, for the Zone's Urunga Convention. He was well rewarded as the event was such a success.

The phone gang have been concentrating on a rare one in AC3PT in Sikkim 14240 kc/s, and has been active around 2300 hours EAST.

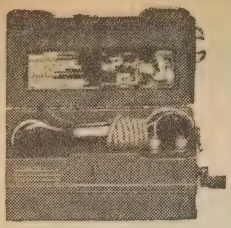
Some of the rarer South Americans have been appearing, too. FY8YC, 14090 kc/s 2130 hours, is the best, while CP5EK, 14040, and CP5EQ, 14090 kc/s, have been representing Bolivia around the same time. The latter's TH is Box 496 Cochabamba. North Americans are still appearing around the long way on 7mc in the morning. KP4, XE, W and VE stations have been heard between 0630 and 0800 hours EAST. Strongest signal was from XE1BV—579, contacting TA3FAS.

SOME PIRATES!

Best pirates of the month were YZ3PO and ZZ1AA in the evening, and SL1PC in the morning. Quite a number of amateurs spent time trying to get QTH's to no avail. SL1PC was reputedly in Visby, wherever that may be.

KC6WD has been active helping KC6WC out in the Palau Islands. His QTH is C9 Depot, Box 3, Navy 926, c/o PM, San Francisco, Calif., USA. Perhaps the new KC6 will answer more VK's. KC6WC had plenty of Australian coal wasted on him.

Last month was listed a proposed new T code sponsored by J. N. Walker, G5JU.



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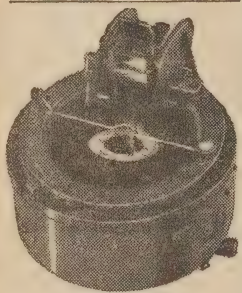

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24-volt, AC, DC, 1/40 H.P. with laminated field. 50/-

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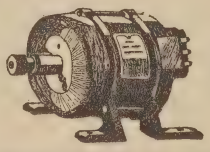

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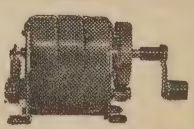

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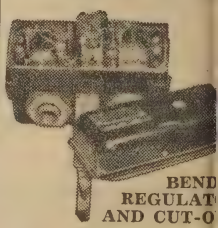

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interesting comment has been made
eas on the system.
particular import are the remarks of
RRI. Communications Manager, F. E.
v, W1BDI. He believes the main
em at the moment is the habit of ama-
giving flattering reports, and any
e from the current T code would not
y the position. W1BDI also believes
he proposed code is too complicated
iat it would be too hard to memorise.
states that greater use should be made
e "C," "X" and "K" to indicate
crystal and clicks, and the addition
" to indicate drift would be a good
ture. It is generally accepted that
ast 40 per cent of the T9 reports
are flattering and really should be
ded at T8 or worse.
the other hand, GM6CIX and others
rt G5JU's proposal. G3HAT suggests
ould be tried for a period in Great
in at least. Reporting generally seems
ax. and the RS section of the RST
comes in for some exaggeration, too.
re is no doubt that most of us have
cial strength estimation for DX sta-
and it is generally an S point or
bove local reports. This condition has
been observed by amateurs who have
ited overseas. It would appear that if
re to make the best use of our present
system we must concentrate a little
r before presenting our contact with
ort.

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UERY is to hand asking how much
formation is required to be listed on
cards to make certain it covers all
equirements for the many DX certifi-
available these days.
e first point is to ensure that you
ly show that the card confirms a
ommon arrangement is the following:
Radio XXX. Your signals HR RST
ten a committee examines such a card
cannot say whether the card covers
a report or is intended as a verifica-
of a QSO. The correct procedure
d be to commence, "To Radio XXX,
rming our QSO," or some similar
gement.
e second point is to show clearly
her the contact is made on CW or
hony. The station contacted may
to use your card toward a Telephony
d.
e third is on the subject of signal
rts — this should be shown clearly.
e a number of societies require a
mum report of R3 and S3; others will
accept cards that show a Tone report
orse than T8.
e final point, and one often missed, is
ing the date of the QSO. Awards
e days are divided into postwar and
ime certificates, so the date is a neces-

you desire your cards to be of use to
rs for the various certificates, make
in at least the above information is
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te for particulars to the Class Man-
r, W.I.A., Box 1734, G.P.O., Sydney.

A simple photo copying method

(Continued from Page 77)

adequately exposed. Such a procedure is hardly practical with the simple process we are considering, and so blueprints must be considered as an unsuitable subject.

While this color discrimination may be a disadvantage in some cases, it can also be turned to good account. A drawing in Indian ink on ordinary commercial graph paper may usually be copied without the graph lines showing in the final print. This is a handy tip for those who like to make their own instrument dials, panel scales, &c., since it is a help to prepare the original copy on graph paper, where the lines help to keep everything straight.

The increased contrast can also be helpful with work of this kind since it tends to mask much of the handwork. Brush and pen marks in the ink, erasure marks and alterations made with white ink or opaque will usually vanish in a high contrast print. Thus what appears to be a rather grimy and patched-up original may well produce a professional-looking duplicate.

This scheme may also appeal to those who like to make their own QSL cards. When it is possible to turn out any number of duplicates, it becomes worthwhile to spend a considerable time on the preparation of the original. It is even possible to paste on suitable material which may be cut from other sources, it being only necessary to see that the changes in thickness are not too great, as this may prevent perfect contact when making the first negative. The joins created by this paste-up technique will be masked by the high contrast of the final print.

Well, there it is. If you have already done some simple printing, you can start copying right away. We think you will find it interesting and instructive, as well as being a handy trick to have up your sleeve.

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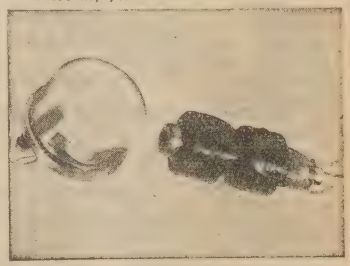

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NOTE NEW TELEPHONE NUMBERS—M 2159, M 2350.

OFF THE RECORD — NEWS & REVIEWS

The first microgroove records to be offered for sale arrived in Sydney a week or two ago in small quantities. It was interesting to note the eagerness with which "M-day" was awaited by an enthusiastic band of collectors, and also the speed with which the records themselves changed hands!

BY JOHN MOYLE

I had scarcely expected that stocks would be so far eaten away in the course of a single morning that I would miss out on the recording of "Petrouchka" which has been so favorably reviewed overseas. Alas, it was so, and I'll have to wait now until next time. Maybe a camp-bed or a queue at 5 am might be wisest!

Seriously, it was good to see the day arrive at last, and I hope that from now on we will have more and more microgrooves available here in Australia.

Some of the record firms may have been a bit doubtful whether there were enough interested people to pay the money for the records to make importation worth while. I think they have their answer now, and realise that it is only a matter of time before the new records take their place alongside the old.

So far I haven't heard many criticisms about the records themselves, which no doubt were carefully selected in the first place. Nor, for that matter, have I seen unfavorable reviews of any English microgrooves to date. I shall be most interested to hear from readers who have bought records, and to learn their reactions, and troubles if any.

The impact of wider range is bound to do things to those who haven't heard it before. Don't be quick to form conclusions until have had a chance to get used to

The cost of the records is li to vary for certain reasons, but guide, those I have referred to for £2/15/- per 12-inch disc. corresponds in most cases to album of four records on 78 rpm that although the microgrooves a little more, it is not a great amo I do not know whether prices for future will vary, or if so by h much.

EQUIPMENT

One of the main considerations be faced before very long will the selection of playback equipm for the chasers after good quality

On the whole, the position been fairly good for the last months in the 78 rpm field. Sev very good pickups, and at least brand of imported speakers, h catered for wide range. The appointment has been that rec surfaces haven't altered materia —not enough anyhow to allow full range to be appreciated. Nor the quality of pressing improved hoped it might. We still get d which go to pieces before the ce is reached, or which for other reas are not playable successfully on w range gear.

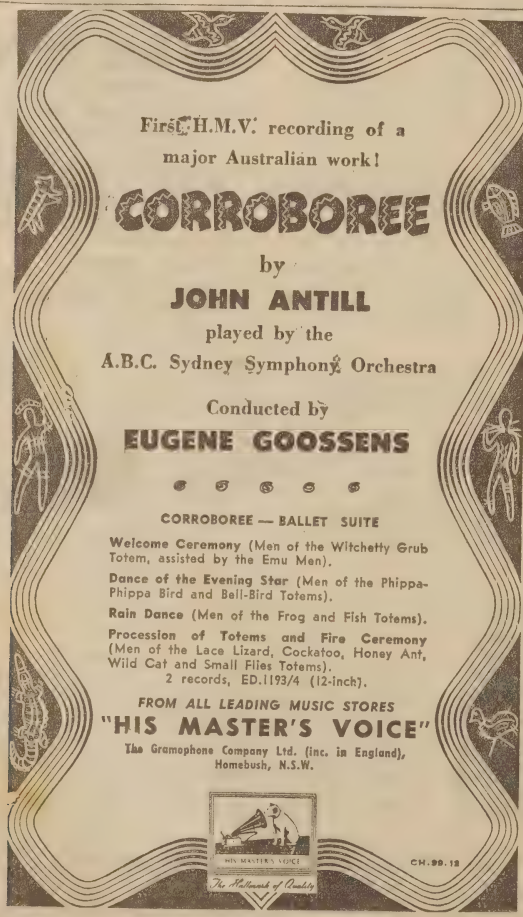
It is too early yet to say m about the microgrooves in this re pect, except that, generally speak the position does seem to be bet It certainly is in the matter of s face noise, so that the extreme h frequencies can now be heard better or for worse. What will worth finding out is whether th are weak links in the chain of pi up, record, and speakers which prevent the full advantage of extra "top" to be realised.

RECORDING CURVE

Essentially, the problem isn't a matter of dumping a record o 33 rpm turntable, hitching up microgroove pickup, and heavin sigh of relief.

We have to consider a new set recording characteristics, for thing, because the microgroove cu isn't the same as the 78 rpm cu The bass turnover point isn't same, nor are the characteristics the top end. There is a certain deg of pre-emphasis to be taken account, if we are interested obtaining a flat response.

I am speaking for the benefit those who operate wide range equ ment. To play a microgroove on average amplifier and speaker wi isn't much good over about 6 kc i eliminate many of the major wor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ich might attach themselves to
records. They will still sound
od, but will lack the full upper
ge.

As I have explained elsewhere, the
cording characteristic for micro-
oves provides an appreciable pre-
phasis in the upper region, the
rpose of which is to reduce effec-
e surface noise. The amplifier
uld provide a de-emphasis or if
u like a tone control effect to
duce the top end by the same
ount as it was originally em-
asised.

OMPENSATION

If this isn't done, the net result is
high pitched, and not particularly
asant. Don't let this put you off
records. Suitable compensation
ll look after it by reducing these
hs, and with them, what surface
ise there is on these quiet discs.
At the moment, we have not been
le to do enough work in this
gard to make definite suggestions
treating your equipment. The
sition is somewhat complicated by
use of various types of pick-ups,
that the right answers might not
forthcoming immediately.

We have, however, commenced
ne experimental work with com-
nsating circuit particularly for use
th the Acos crystal pick-up, which
rrespondence shows is widely used
microgroove work. This is a good
ck-up from the point of view of
ear and high output, but has a
rve far from flat. It should be
ssible to work out a condenser
sistor combination which will
gely correct it, however, par-
ularly to remove a peak about
c which seems to be characteristic
this type. This peak would tend to
centuate the high-pitched effect of
aying microgrooves without com-
nsation.

RESENTATION

We may have the opportunity also
test other pickups as they come to
nd, and thereby present a useful
ference article when further experi-
ce allows the material to be
thered.

I don't think I have yet mentioned
e most attractive envelopes in
hich the records themselves are
used. These are made from quite
avy cardboard with a smooth sur-
ce to give maximum protection to
e surface. The front face carries a
itably decorated title with illus-
ation in color, and on the back is
variably printed a commentary on
the work, taking the place of the leaf-
let usually issued with albums of 78
records. In two corners of the en-
velope are indexing numbers which
make it easy to pick the envelope
from its companions.

I'd like to refer here to the wisdom
of keeping your fingers off the record
surface. The finer grooves must be
treated with even greater respect
than the 78 types, and you should
keep a special hatchet for anyone
who spreads his fingermarks all
over the surface. I have even washed
microgrooves with soap and water
to clean off such wicked collections
of grime, but although the process
didn't appear to unduly affect the
surface, there is absolutely no point
in inviting trouble. See also that your
fingernail doesn't sweep over the sur-
face as the record drops back into
its envelope.

Most prudent record collectors take
great care along these lines with all
records, and to them the suggestions
will not be news. But with the finer
grooves, it is still more important to
be careful.

Fortunately, microgroove pickups
are extremely light, and a careless
swipe with the stylus point isn't
necessarily as tragic as might be
believed. But it pays not to tempt
providence.

STYLUS WEAR

I have had a couple of letters,
among the growing pile of screeds
received from record lovers, query-
ing the seriousness of stylus wear
with microgrooves. Some figures were
published recently obtained from an
overseas report which seemed to
indicate a rather serious replacement
problem.

It's too early yet to estimate point
life with processed microgrooves
only. Most of my own playing has
been with acetate records, and I
haven't yet been able to wear out a
point to give a lead.

It is quite likely, however, that for
the very finest equipments, using
extremely wide-range speakers, a
deterioration in quality will be
noticed long before those using more
average gear can detect it. It may
be that diamond points might be best
in such cases, just as they are be-
coming more favored for 78 rpm
records of high quality.

OLD PROBLEM

But the point I make is that wear
of this order is quite different from
wear so bad that records begin to
suffer. It is quite likely that points
will be usable for periods many
times that required to show up some
deterioration in extreme response.

But this is nothing peculiar to
microgrooves. It has always been the
case, and is largely why the trend
has been toward sapphire points as
against steel.

As our technique improves, the
demands placed on equipment must
increase as well, and we must be
prepared to be more particular with
it as our results improve. In other
words it is merely the extension of
a problem which has always been
with us. For the time being, I'd sug-
gest we wait and see just how
important it is likely to be in every-
day practice.

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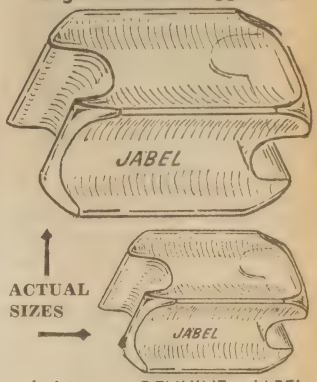

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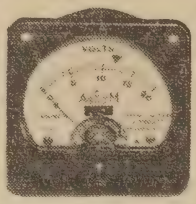

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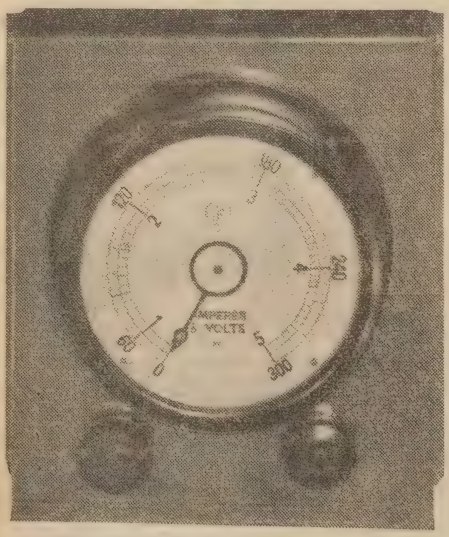

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Vulcan Blows His Fire

(Continued from Page 13)

essary for the production of gas
ntermittent.

n such cases the vent in the upper
t of the column is difficult to keep
n. A stage is reached when the
a can no longer be kept molten.

t must be borne in mind that the
perature of molten lava at the
face is about 1000 degrees Centi-
de. At this temperature, without
gaseous transference of heat de-
ibed above, the loss of tempera-
e by radiation is very great. It is
great, in fact, that the lava in
neck of the volcano can solidify
a depth of several hundred feet
one day.

ESSURE PLUG

This solidification results in a solid
ig of lava filling the neck of the
lcano. The volcano may remain
rmant for many years while the
essures at the base of the plug
adily increase as the hot gases
m again and rise.

The heat from these gases melts
e bottom of the plug so that when
e weight of this plug is no longer
le to withstand the upward pres-
re it is forcibly ejected from the
ck of the volcano by a major ex-
osion which can devastate the
untryside for many miles. A simi-
r form of explosion caused the
saster of Mount Lamington.

This process of intermittency con-
nues for centuries, and the ash and
her products of the explosions
cumulate around the rim of the
nt.

The result is the formation of a
ne crater which gives the char-
teristic conical appearance of the
olcanoes of history.

The volcano will finally become
tinct, even though this may take
nturies, for there comes a time
hen the supply of heat transferring
as in the chamber below the plug
ves out.

WO VARIETIES

The lava itself is interesting. It
of two varieties, namely ACIDIC
nd BASIC.

Acidic lava is lighter in weight
nd color than the basic, and con-
sts mainly of silica which melts
t an extremely high temperature.

Basic lava consists largely of lime
nd soda which also act as fluxes,
aus causing rock and other sub-
tances to melt at a lower tempera-
ure.

It is the basic type of lava which
lows more readily and forms the
estructive streams which cause so
nuch damage.

Acidic lava solidifies more rapidly
nd tends to build up around the
rater of the volcano.

In both cases the solidification takes
lace more rapidly near the surface
han at the centre, so that large
nasses of lava may take years to
ool right out.

During a major volcanic eruption,
eavy rain may fall. This is caused
by condensation of the large masses of steam which may be ejected to heights of many thousands of feet.

To counterbalance the destruction of volcanoes to some extent, there are several advantages which accrue from a volcanic eruption.

The soil around volcanoes (active or extinct) is always of great fertility. This is why villages are built on the slopes of such active volcanoes as Etna and Vesuvius. Even after having been driven from their homes by intermittent eruptions, the villagers always return to work their farms because they know that they will be well rewarded by rich harvests.

In Australia, in such places as the New England district of New South Wales and the Darling Downs of Queensland, the soil is of volcanic origin.

In the Darling Downs the soil is rich and black, and sometimes 40 feet thick. The black soil plains of other parts of Australia are also of volcanic origin.

Again we have such products as blue metal which is extensively used for road making. Sulphur and pumice stone are also valuable products.

Precious stones and metals owe their existence to volcanic action, and the land has been so altered throughout the ages that mountain ranges, rivers, and lakes have been formed for man's benefit.

It is the study of such matters as has been described that occupies the attention of the vulcanologist. To these and many other factors, too technical to be described in an article such as this, the expert gains the knowledge to tell whether a new volcano such as Mount Lamington will remain active or die away. He can tell when the next eruption is likely to take place and whether the eruption is likely to be violent, whether it will erupt mud, lava, rocks or only steam.

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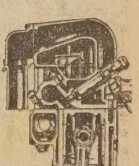

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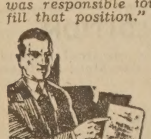

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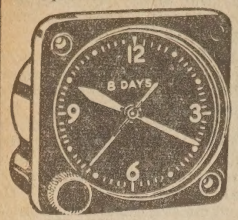

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KEEP YOUR HEADLIGHTS BRIGHT

(Continued from Page 83).

the ammeter-fuse assembly. T surface of the metal becomes co roded and cannot be easily clean because of its position.

Furthermore, the fuse clip, whi is generally of plated spring materi often attaches to this bonding str by nothing more than a simple tub lar rivet. The same is true of t other end of the fuse holder. Aft corrosion sets in, a damaging amou of resistance can develop across th connection.

In actual fact, much of the volta drop which is blamed on to fus can be traced in reality to the rather primitive connections. U fortunately, the fuse holder usually in an awkward position ar repairs cannot be effected in ma cases without removing the assen bly or lowering it into a more acces ible position.

USE SOLDER

Don't fiddle with the rivet b cause it is an unsound connectio anyway. The best plan is to scra the metal clean and to flow sold around the base of the fuse cl and on to the connecting strap.

While on the job, clean the insi of the fuse clip, spring it togeth a little and fit a new, clean fu of the recommended type.

Pass on to the switch connectio and clean as before. Check th switches also for voltage drop d to internal resistance.

The next "hot spot" is likely be the wire junction near the wing Some cars have a plug-and-sock system, others simply have sprin connectors in the line covered by rubber sleeve. The spring conne tors can get atrociously dirty, eith from road dust or engine oil (both) and may require liberal trea ment with petrol, emery and plie before a good connection is re-estab lished. The rubber sleeving wi probably be perished, so seal th junctions carefully with adhesiv tape.

Plugs and connectors have to b treated on their merits. Sprin plungers sometimes become stuck i the sleeves and may be freed i many cases by washing in petrol an gentle working with pointed pliers.

DRASTIC ACTION

If a voltage drop persists acro the joint, as measured with a vol meter, the best method is often t cut the faulty plug out altogethe solder the wires and tape the joint To make a job of this, you will hav to splay the individual strands, clea them as best you can with emer paper, brush them with petrol an then go to work with a clean, h iron and some potent flux.

Use more petrol to wash a the excess flux before tapin joint.

Inside the headlamp, make that the spring contact plungers the lamps are working freely, a clean their tips as well as the c tacts on the base of the lamp.

This done, you can assume tha

ANSWERS TO CORRESPONDENTS

A.V. (Port Adelaide, SA) sends in a contribution for the Let's Buy An Argument feature.

A.: Thanks for your letter, A.V., which has been put aside for future use. We like to acknowledge the letters as soon as possible but you will appreciate that we need to preserve some sort of continuity makes it necessary to depart from this procedure on occasions.

P.P.T. (Singapore, Malaya) submits a simple design for the Reader Built It one of the magazine and also asks a few questions on valve cathode voltages.

A.: Thanks, P.P.T., for your contribution to the Reader Built It page and we are holding it pending possible use in a future section. Reducing the heater voltage of a valve cathode limits the emission capabilities of the surface and, in the case of the rectifier, would tend to increase its internal impedance. Actually, it is unwise to operate any valve at less than 90 pc than its rated heater voltage, except when circuit conditions permit the plate current to a very small fraction of the normal maximum rating. A reduction to about 70 pc of normal heater voltage is permissable in a resistance-coupled amplifier but any attempt to operate the same valve with full plate current under the same conditions could result in "poisoning" the cathode surface. Because of all this the idea controlling voltage or receiver gain by varying the temperature of the rectifier or heater cathodes is not a good one. The A.C. went out with the old tungsten filaments.

T.R.M. (Brisbane, Qld.) writes a letter of appreciation for the assistance and interest which the magazine has been able to provide for him.

A.: Thanks for the letter, T.R.M. We are pleased to note that you have constructed several of the sets which have been described in the magazine and we trust that your future attempts meet with the same degree of success. We trust also that all future issues of the magazine continue to hold your interest.

R.S.F. (Burwood, NSW) wishes to construct a voice coil high-pass filter with a turnover frequency of 20 cps.

A.: We assume that your intention is to remove motor rumble and so on from the reproduction but since circuits to operate at voice coil impedance and at this frequency would involve enormous values of capacitance the scheme would be impracticable. The only possibility would be to construct a filter to work at high impedance, perhaps in the pickup circuit. However, we cannot give any precise information, since we have never had occasion to conduct experiments along these lines.

R.S.T. (Oakleigh, Vic.) seeks some further information on the subject of radio control, particularly in the matter of carrier current systems.

A.: We regret that we have not carried out any experiments with carrier current systems and our files do not contain any circuits which might help you. From your previous letter we judged that you had the necessary circuit details and merely wished to change the frequency, in which case it should be possible to incorporate the oscillator circuit we mentioned in the circuit you already possess. We suggest that the Public Library may be able to put you on the track of some further information on this rather specialised subject. We regret that it would be impossible for us to search our records for the origin of an article which appeared so long ago.

E.A.S. (Gippsland Lakes, Vic.) has purchased a commercial kit for the Karset and requires additional information. He also inquires about subscription rates to Radio And Hobbies.

A. We can supply circuit diagrams and parts list for the Karset through our postal service, price 1/6. The original article was published in Radio And Hobbies for May, 1949, but unfortunately this issue is no longer available. The subscription rate to Radio And Hobbies is 12/- per year. Many thanks for the information regarding YDL station Padang, Sumatra. We will pass this information on to our shortwave contributor.

I.R.T. (Erica, Vic.) forwards subscription for 12 months and requests some information on alignment procedure and also a circuit for a three valve regenerative receiver using modern 1.4 volt valves.

A. Many thanks for your subscription which has been forwarded to the appropriate department. A pamphlet is available through our postal service, price 1/-, covering the alignment of receivers. The only circuit in our files similar to that which you require is the 1K5-Three, which was originally described in August, 1947. This set uses the two volt 1K5 type valve and as originally designed called for 135 volts on the plates. However, the set should work reasonably well with a high tension supply of 90 volts allowing for some reduction in output. Circuit diagrams, &c., of this set are available through our postal service price 1/6. We are not in a position to quote the cost of receivers described in Radio And Hobbies, but suggest that you contact some of our advertisers.

R.L. (Wagga NSW) makes some inquiries about the oscillator described in Radio And Hobbies for May, 1947.

A. When using a 150 volt power transformer the first 5000 ohm resistor could be omitted. The second 5000 ohm resistor is part of the filter circuit but possibly this could be reduced if necessary to provide sufficient voltage. The governing factor here would be the amount of hum resulting from such reduction but with higher value capacitors as you suggest, this may not be serious. A push-pull audio transformer would probably be satisfactory but it may be necessary to experiment with values around the audio oscillator circuit in order to secure a satisfactory tone. The value of resistor connected to the CW-MOD switch is shown in the original circuit as 50,000 ohms.

B.G. (Orange, NSW) is having some hum trouble with a home-built receiver and would like some advice as to probable causes.

A. It would be easier if we had the circuit, B.G., and if the following suggestions do not help, you may care to send it along. From your description we take it that the trouble is in the plate, but not the grid, of the audio valve (EBF35). This would seem to suggest poor filtering of the HT for this stage and, if the plate circuit is not already de-coupled, we suggest that this be tried. Between the plate load resistor and the HT supply, insert a resistor of approximately 50,000 ohms. The junction of these two resistors is now by-passed to earth with an electrolytic condenser of 8 or 16 mfd. If this does not improve the condition and you are able to supply more details we may be able to help you further.

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FOR SALE: HRO type geared dial, hardly used, £5/-/-. TA120 Bandswitched x-mitter 10, 20, 40, 80, 100 watts, VFO. All valves—no power supply or mod. FM attached, £20, offer. **S. E. Widgery, 703 Macarthur St., Ballarat, Vic.**

FOR SALE: University supertester, as new, a bargain. **C. Simpson, 20 Geel St., Bentleigh.**

FOR SALE: Late VK2ALC ham rig M/F H/F and VHF and many radio parts. 60 valves. **LW5339 Bockman, 31 Prospect St., Carlton.**

FOR SALE: 40 watt PA amp k built, radio channel PU and two MIC inputs, complete faders and tone controls. Two 12" baffled speakers. Matched red line transformers. **Ring BX5061, Mr. Keith.**

SALE: "Avo" multimeter, model 7, also "Avo" all-wave signal generator, batt. model. Must sell, best offer. **Wadey, Thompson St., Clayton, Melb., Vic.**

SALE: 2 811 Valves, 1 813 Valve, any reasonable cash offer. **89 Victoria Avenue, Mortdale, N.S.W.**

SELL: RH triode connected 807 amplifier RH V.T.V.M. odd assortment radio gear, any item sold separately for best offer. **Apply K. Cole, c/o Tazewell Radio, Goulburn.**

SELL: Sylvania Electric 5" 16 tube oscilloscope, T/Base 15 cs—30 Kc/s, fixed and variable I/P attenuators, amps "X" and "Y" in or out, facilities for external T/Base and sync excellent appearance and condition, £55. Absorption Wave meter AM Type, 2 valve circuit, elaborately constructed, charts, spare valves, 0-100 micro meter carrying case, £15. **L. Christensen, 36 Victoria Cres., Mont Albert, Mel. WX3665.**

SELL: Clearance of surplus radio component parts at cost. Also Kingsley communication receiver and No. 19 and No. 11 Army disposals sets. What offer for sets. Write for prices. **R. Bennett, Factory St., Pomona, N.C. Line, Qld.**

SELL: BRS junior recorder, 78 rpm. Excellent condition. £32. **P. Horne, 71 Malabar Rd., Coogee. FX6472.**

SELL: Palec VCT-V tester, relay rack, crackle panels, meters, various gear No reasonable offer refused. **VK2ANX, 20 Atkins Rd., Ermington.**

SELL: AR8 receiver; 109 receiver; No. 11 Aust. transceiver, TR1196A, FS6 complete, Type A Mark III. Complete with spares, inverter HD 200 DC/230 AC incl. pair 110V Mallory vibrators. Further partics. **A. Jacka, Box 51 Bairnsdale, Vic.**

SELL: Two-speed recorder BRS in polished case, £33. Steane Torpedo Velocity Mike, £5. Offers, **Box 296, Lismore 4C.**

SELL: 813 built-up final with fill. trans and 20 meter coils, £5; pair 866s, £2; 9 1.4 volt tubes, new, £4; 11-tube ham receiver, £15. Ferranti 0-150 milli. meter, £1 Weston dual 0.40 and 0.120 milli., £1. metre Xtal 8541, 10/-. **A. B. Clark, 35 Moxon Rd., Punchbowl, NSW.**

SELL: Kingsley AR7, 2-6AK5 RFs, 5 Coil Lenses, 200 K.c. to 27 M.C., 240 V.A.C., 12 V.D.C., with 12" speaker, dynamic headphones, chrome face and dial as new. £43. S.C.R. 522, £12/10/-. Transmitter, £55. **A. F. Graham, Goldieslie Rd., Indooroopilly, Brisbane.**

SELL: 100w Transmitter ex Admty, consists of 813 P.A. 3 stage driver unit or Xtal exciter, aerial coupling unit. Modulator P.P. TZ40's Driven by P.P. 6L6's; control panel and 2 1KV 500 mA. power supplies. Units are of chassis and panel const. mounted in 6' encl. steel rack. **A. W. Rushby, 20 Codrington St., Fairfield.**

SELL: Type 3 Mk. 11, new full kit spares. **K. Goodes, D.C.A., 475 Collins St., Melbourne.**

WANTED: Power supplies and cables for FS6. **Lang, Titanga, Lismore, Vic.**

WANTED: Receiver MCRI, BC454 Transceiver AMK 111, FS6 or equivalent, complete, good condition. **Lang, Titanga, Lismore, Victoria.**

WANTED: Receiver BC348 Q. Preferably unconverted. **Charnley, 42 Garfield Ave., S.E.9, Melbourne.**

WANTED: 6U5/6G5 electron ray tube. **Dehn, 48 Wangee Rd., Lakemba, NSW.**

WANTED: Kingsley AR7 coil box "E" approx. 12-30 m.c. Quote price to **Collins Radio, 409 Lonsdale St., Melb.**

WANTED: Modulated Oscillator, A.C. vibrator or battery operated. Home built will do. **Robertson, Marrinup, W.A.**

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